DEFENSE SYSTEMS MANAGEMENT COLLEGE

NAVIGATING THE DIGITAL ENVIRONMENT: A PROGRAM MANAGER'S PERSPECTIVE

Report of the
Military Research Fellows
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PREFACE

This research report encapsulates an 11-month Military Research Fellowship, chartered in 1987 by the Under Secretary of Defense (Acquisition), today known as the Under Secretary of Defense (Acquisition and Technology). This fellowship program, managed by the Defense Systems Management College, is a unique opportunity for selected officers to supplement Department of Defense (DoD) research goals and to impact the Defense acquisition process. The fellowship has two primary goals: first, to provide an advanced professional education for selected military officers from the Army, Navy, and Air Force; second, to conduct independent research exploring new and innovative concepts to benefit the Defense acquisition community.

The research fellowship begins with an intensive 12-week international executive education program at the Harvard University Graduate School of Business. The Program for Management Development (PMD) is a resident program involving a highly select group with over 130 executives from 32 different countries. Using the renowned "case study method" pioneered by the Harvard Business School, PMD features detailed examples derived from actual business situations that are relevant to current global business trends and economic conditions. Focus modules include Foundations of Finance; Achieving Breakthrough Service; Building Operating Capabilities; Marketing Management; Competition and Strategy; Finance and Management Control; Human Resources Leadership; and International Business, Government, and Trade. The constant daily interaction between professionals with such diverse social, political, business, and management experiences, offers perspectives that are impossible to replicate in a DoD educational environment.

The remainder of the fellowship involved developing and conducting a joint research project, culminating in the publication of this report; and presenting a series of briefings to DoD acquisition officials. In our early investigations, we noted that many of the goals of current Acquisition Reform initiatives are based upon notable successes achieved in the business community as they move into the information age. Looking more closely, it became clear that much of the success in industry was made possible only through the effective development and use of an integrated digital environment. This environment enabled improved communications, data sharing, and business process improvement and reengineering. The exploitation of a digital environment has become a necessary precondition to achieving the significant cost savings, reductions in cycle time, improved management efficiencies, and optimized life cycle support that are acquisition reform goals.

Unfortunately, we also found the acquisition community is currently not well positioned to take advantage of this emerging field. There is no *single face* or voice that guides program managers (PMs) in their efforts to move into the information age. The DoD initiatives to develop integrated digital environments and operations are disparate. Education and training programs are functionally based, and do not address an integrated approach to management, information, or process improvement. While many PMs are attempting to be innovative and exploit digital technology,

for the most part their actions are independent initiatives and do not reflect a concerted and coordinated effort on the part of DoD. This report is intended to assist PMs and their staffs understand the digital environment. It does so by: (a) describing the digital environment; (b) examining the major players promoting the integrated digital environment and their roles within the acquisition community; (c) identifying the need for an integrated digital environment; (d) describing the experiences in the field of "going digital;" (e) providing a roadmap for the PM that can assist in exploiting an integrated digital environment; and (f) discussing relevant issues and offering recommendations for the future.

This challenging research endeavor would not have been possible without the support and cooperation of many people. We are incredibly grateful for the Harvard Business School experience. The faculty, staff, and our fellow PMD participants helped us to grow professionally and personally in ways that are difficult to describe, impossible to measure, but will remain with us forever. We wish to thank Dr. James Price, Dean, Research, Consulting and Information Division at DSMC, for his helpful advice and guidance throughout the research effort; and Ms. Kathy Smith, administration support to the Faculty Division, did a great job of transcribing over 100 hours of taped interviews.

This report also would not have been possible without the cooperative spirit of the DoD acquisition community. We conducted more than 100 interviews with key personnel from government, industry, and academia who were involved in the exploitation of the digital environment. While they all deserve individual recognition, in all fairness there are too many to mention by name. All our interviewees were candid and very accommodating. We sincerely thank them for all their contributions. To them we say we hope you find this report as helpful to you as you were to us.

The Research Fellows also extend a special note of thanks to Ms. Joan Sable, Research Associate and coordinator of the Military Research Fellowship. Her assistance throughout this program, both at DSMC and Harvard, helped everything run smoothly and allowed us to keep focused on our research.

Finally, none of this would have been possible without the love, sacrifice, and support of our families. Extended absences, numerous trips, and the general intensity of independent research made this a challenging year. Their patience and understanding were crucial. We owe them everything.

1

INTRODUCTION

Purpose

This report provides a comprehensive examination of efforts to exploit the digital information environment, and their application within Defense acquisition programs. While relevant to the entire Acquisition Community and their industry counterparts, the target audience is the Department of Defense (DoD) Program Manager (PM) and Program Management Office (PMO). They have the ultimate responsibility of meeting the needs and achieving the goals of an acquisition program, but have not been well prepared to capitalize on the emerging information age. In this research, we develop the concept of an Acquisition Program's Digital Environment (APDE)[1] to describe a cross functional integrated digital information infrastructure that supports a DoD acquisition program. The APDE links the entire acquisition program team, to include not only the PMO and prime contractor personnel, but also subcontractors, vendors, suppliers, support agencies, and end users. An APDE can take many forms, depending largely upon the extent to which an acquisition program is able to exploit digital information technology and integrate processes efficiently and effectively. If increased productivity and substantive cost savings through process improvement and reengineering are program objectives, evidence shows that such a digital environment is a key enabler and a necessary precondition for success.

Program Manager

In the DoD, PMs are selected for a new or legacy acquisition program[2] because they are professionally competitive and meet the requirements of the Defense Acquisition Workforce Improvement Act (DAWIA).[3] PMs generally arrive focused on a vision for their new domain. They understand the users' requirements and are prepared to implement those business processes they believe to be compliant, appropriate, and sometimes innovative. They may have helped build financial estimates and feel comfortable with the budget cycle, or even helped persuade a financial oversight committee to restore the funding of a program. In some cases, PMs may have been through a couple of difficult senior program reviews, and know how to effectively navigate to the next major milestone. Despite what PMs may or may not have experienced, the acquisition landscape is changing within the DoD. The recent introduction of the Federal Acquisition Streamlining Act (FASA), along with new implementation initiatives such as integrated product and pro-

cess teams, process reengineering, process improvement, and down-sizing are all testimony to the most recent visible changes. There is yet another significant change taking place that is even more dramatic yet somewhat obscure—the process of *integrating digital environments.* The following questions might be typical of a PM's response to such an initiative.

- Is it necessary?
- What does it really constitute?
- Who in my organization can help explain it to me?
- Where else do I go to learn about integrated digital environments?
- Is it or should it become one of my core competencies?
- What are the directives and/or mandates that govern its implementation?
- What is my motivation to implement integrated digital environments?
- Will it help me do my job faster, better, smarter, cheaper now?

Digital technology is not really new at all. However, the emerging technologies to employ it in an integrated fashion are evolving so fast that it is outpacing the time necessary to understand how we can make an integrated digital environment work and ultimately capitalize on its benefits.

Many compelling arguments can be made that easily justify the need for PMs to better understand and appreciate the benefits of integrated digital environments. For one, "going digital" is now guidance for those of us involved with DoD weapons system acquisition. One key element of the DoD Regulation 5000.2-R directs by fiscal year 1997 "all new contracts require on-line access to, delivery of, their programmatic and technical data in digital form, unless analysis shows that cycle time or life cycle costs would be increased by doing so."[4] However, recognizing that the development of an integrated digital environment can save a program time, money, and improve process efficiency provides greater significance.

Digital Fog

From the beginning of our research we detected a digital fog that can easily screen the PM's view of digital information environments. The DoD and industry have been incorporating many digital initiatives for streamlining, promoting greater competition, and improving business practices for the last decade with a confusing number of digital directives, digital standards, and digital strategies. Integrating digital information environments is relatively recent and revolutionary. Notwithstanding, there is no single organization in the acquisition community responsible for developing and maintaining a roadmap that would help PMs navigate their respective digital domains. According to one PM, "the lack of definitive guidance and a prescribed way to do it are the biggest blocks. We are having to feel our way through and we may be going down a dead end path."[5] Not surprisingly, the employment of integrated digital environments within PMOs has been disparate. The creation of one might be constrained both by the PMs' vision and their budget even though they may recognize "information technology must be viewed as an investment."[6]

Each PM is hired to produce a quality system that meets the user's needs within budget and

on time. Their plan of action is governed by Federal Acquisition Regulations (FARs) which require that PMs develop an *acquisition strategy* early that addresses the mission need in the most effective, economical, and timely manner.[7] Even though available guidance on how to best exploit the digital environment to support their strategy has not yet materialized, *a few* program offices have taken advantage of the enabling and evolving digital resources. On the other hand, increasingly more industry partners are designing, manufacturing, testing, and supporting defense systems within digital environments, developing new systems digitally, and creating dynamic digital enterprises. Since the PM is at the center of gravity and considered an integral member of their weapon system enterprise, it is vital that the PM embrace an integrated digital environment before they can ever hope to best exploit it.

Since 1988, the DoD has spent between 4 and 5 billion dollars fueling the many components of an Integrated Data Environment (IDE) in its attempt to accommodate the delivery of digital product data to the weapon system sustainment communities. Despite DoD's efforts, however, an IDE's benefits to the acquisition community are not always well known, well understood, or well communicated. In some cases, promises of significant overall cost reductions are not even believed. DoD training courses are targeted toward logisticians, contracting officers, engineers, and data managers. They do not focus on PMs or on integrating processes. Compounding the problem is the fact that the basic construction of a robust IDE may not come cheap. There is now an issue of who pays. In light of shrinking Defense budgets, PMs may be left with doing everything they can to simply sustain their program and still satisfy the user's needs. Since 1994, some major weapon programs have had to realign their program, annually, because of congressional directed funding reductions. It is easy to understand why resources necessary for a robust digital environment may be sacrificed; PMs may not easily envision a return on investment during their watch. Clearly, before committing any program dollars for an APDE, the PM needs to know what is important and what works today before the DoD can expect them to "buy-in" to the proposed merits of an APDE such as:

- Cost savings;
- Reduction in cycle time;
- Improved life cycle support;
- Increased process and product coordination;
- Suitability and quality of data;
- Greater access to data; and
- More timely decisions.

Methodology

We systematically approached the topic of digital environments and generated our hypothesis—that developing an APDE is important to PMs—well before we knew much about the subject matter. We conducted an initial literature review of Defense Acquisition University (DAU) web sites on the Internet. We concentrated on Electronic Commerce (EC), Electronic Data Interchange (EDI), Continuous Acquisition and Life-Cycle Support (CALS), and overall Digital Environment (DE) activities. We visited over 200 other related global Internet sites and discovered them to be wealthy sources of information. These virtual visits helped us qualify our research and establish key points of contact early. The Internet

alone helped streamline access to what information we really needed, expediting the first stage of our research efforts. Because of the magnitude of the research domain selected, the Internet served as an additional quick look assessment of pertinent literature. Embedded at each site were also connections or *hot links* to other sites that increased the sites' value and extended our reach to applicable organizations. In most cases, the Internet also provided details about the organizations we wanted to visit. As a result of this preview, we were better prepared for our site visits.

We conducted in excess of 100 interviews with over 40 separate DoD PMOs and defense contractors within the United States. These particular site visits were the most useful element of our data collection. They provided a realistic snapshot of how organizations viewed and employed variations of APDEs. In order to allow for open and honest discussions with PMOs and industry, we agreed to the accepted principle of non-attribution, whereby no individual or organization would be referenced directly without permission. Thus, in some cases, this book cites information derived from interviews not attributed to a specific source.

We developed a questionnaire that was sent to each site prior to our visit. This questionnaire served as a baseline for our discussions and helped each organization bring together their interview teams. We also derived additional question sets that were tailored to each individual site.

Objectives

We selected our research topic because of our own desire to understand integrated digital environments, identify how to best exploit them, and determine their application to the PM. We also wanted to apply what we learned from the first phase of our research fellowship, attendance at the Harvard University Graduate School of Business Administration. Our Harvard experience was extremely rewarding and provided unique business perspectives outside the DoD that could be applied to many DoD processes.

We quickly found that it was important to anchor our research because of the extensive scope of the overall digital environment. We therefore established the following framework for our report:

- Target audience is the Defense acquisition community;
- PMs need a working level understanding of the environment;
- PMs need to be aware of the benefits of an integrated digital environment;
- PMs need to understand the experiences of others in the field;
- PMs need a step-by-step approach how to exploit the digital environment today with current technology; and
- PMs need to appreciate the issues and know where to go for help.

1. APDE is an acronym used throughout this report to depict a proposed model for working within the digital environment. However, it is not an official DoD acronym.

2. A directed, funded effort that is designed to provide a new or improved materiel capability in response to a validated need. (See DoD Directive 5000.1, reference (g).) Acquisition programs are managed, in accordance with reference (g), DoD Regulation 5000.2-R, and related DoD issuances.

3. Public Law 101-510, Title XII (10 U.S.C. 1701-64 of Title 10, United States Code), Section 815, Defense acquisition workforce improvement act, adopted by Congress in 1990. [On-line]. Available Internet: http://www.dtic.dla.mil/acqed2/legislation/hlang93.html

4. Office of the Secretary of Defense. (March 15, 1996). Department of Defense Regulation 5000.2-R, mandatory procedures for major defense acquisition programs (MDAPs) and major automated information system (MAIS) acquisition programs, paragraph 3.3.4.5. Washington, D.C.: Author.

5. Personal interview with a DoD PM April 1996.

6. Gauthier, M. & Clavier, C. (26 Apr 96). LPD 17 designing for ownership. Presented at the Association of Science and Engineering 33rd Technical Symposium (Approved for public release, distribution unlimited, Amphibious Transport Dock Ship Program Office, Naval Sea Systems Command).

7. General Services Administration. (March 1996). Federal Acquisition Regulations (FARS) Part 34: major system acquisition subpart 34.0—general para 34.004. acquisition strategy. [On-line]. Available Internet: http://www.gsa.gov/far/90-37/html/34.html

2

DIGITAL ENVIRONMENT

Background

In order to fully appreciate why and how to transition to a Digital Environment (DE), it is necessary to have a basic understanding of the environment, ongoing initiatives, and those agencies that play the most active roles. This chapter will discuss the background behind the Department of Defense (DoD) efforts to establish a DE, provide working level definitions of the common terminology, and explain how and where current initiatives are focused.

History

The current DoD effort to move acquisition and logistics into the digital age began in late 1984 with the enactment of Public Law 98-525 *Plans for Management of Technical Data and Computer Capability Improvements*. An outgrowth of this Law was an Institute for Defense Analysis (IDA) study released in June of 1985 that recommended a strategy and master plan for Computer Aided Logistics Support (CALS) for management of technical data. A policy memorandum entitled *Computer-Aided Logistics Support* signed by the Secretary of Defense in September 1985 established a DoD CALS office with the goal of implementing the recommendations of the IDA study. The goal of CALS was the digital acquisition of logistics information products to include technical manuals and training materials, technical data packages, and product definition data.

Starting in the late 1980s the role of CALS grew. The definition of CALS changed in 1987 to Computer-aided Acquisition and Logistics Support. This change in scope attempted to move CALS from a logistics focused program to a weapon system life cycle focused program. Also during the late 1980s, other digital information initiatives, such as Electronic Commerce/Electronic Data Interchange (EC/EDI) emerged to enable computer-to-computer exchange of business information. The cost of computer-based transactions was dramatically reduced, increasing efficiency and reducing errors largely by eliminating rekeying of data. EC/EDI also provided a standardized means to integrate business functions, enable process improvements, and establish a basis for virtual enterprises.[1]

This transition in scope continued in 1993 when CALS was again renamed, this time to Continuous Acquisition and Life-cycle Support. This title explicitly expanded the role of CALS to a total life cycle focus.[2] During this period EC/EDI were part of the CALS Office that re-

ported to the Deputy Under Secretary of Defense (Logistics) (DUSD(L)). In 1994, Public Law 103-355, *Federal Acquisition Streamlining Act (FASA)*, directed that the Federal Government possess the capability to support EDI-based procurements up to $100,000. That year, EC/EDI responsibilities were moved from the CALS Office to an Electronic Commerce (EC) Office, established under the Deputy Under Secretary of Defense (Acquisition Reform) (DUSD(AR)). While supporting DoD-wide efforts to enable the exchange of a variety of business processes through EDI, the primary responsibility of the EC Office is to manage the implementation of EDI-based contracting.[3]

Recognizing the fact the CALS effort started in the logistics community and organizationally remains under logistics makes it exceptionally hard to overcome the stereotype that CALS is a purely logistics program. Interviews with several senior DoD officials highlighted CALS current efforts primarily concentrate on logistics and sustainment activities. Similarly, EC Office efforts have been largely directed at the contracting community and small procurements, despite significant support to other EDI-related business processes. While both the CALS and EC/EDI offices are working to advance the Acquisition Community, the perception in the field is that they are separate, functionally based initiatives that do not specifically focus on, or address the information and business needs of the Program Manager (PM).

In addition to the CALS and EC/EDI offices, the Office of the Director, Defense Procurement and the Defense Information Systems Agency (DISA) also have active roles. Thus, spreading the responsibility for the digital environment across several organizations. Research interviews found this to be a concern within Program Management Offices (PMOs) and industry, as decision makers attempt to identify who is in charge.

Major Players

While DoD would like to present a *single face* to industry, the Services, and PMOs, there are a variety of organizations involved in different aspects of the digital environment. A digital environment that supports the acquisition community must interconnect with the defense information infrastructure (DII) which, in turn, is an integral part of the national information infrastructure (NII). Agencies, apart from DoD, such as NASA, Department of Commerce, Department of Treasury, and Department of Energy are also affected. Business processes and standards clearly have applications beyond the Federal Government. With global business partnerships becoming more commonplace, there are international as well as national implications, and industry plays a critical role. This section describes some of the major players involved in aspects of the digital environment, particularly as they impact the acquisition community. While many of these organizations will not directly affect PMOs, it is useful to understand their areas of focus and the roles they play (see Figure 2-1).

DoD CALS Office

The DoD CALS Office, under the DUSD(L), is responsible for leading the DoD CALS effort. The CALS Office responsibilities include:

- Coordinate with appropriate Principal Staff Assistants (PSAs) to define the Integrated Data Environment (IDE) for business and technical information used in support of system acquisition and life cycle support. The IDE will be congruous with industry practices and the overarching DoD information infrastructure being developed by DISA.

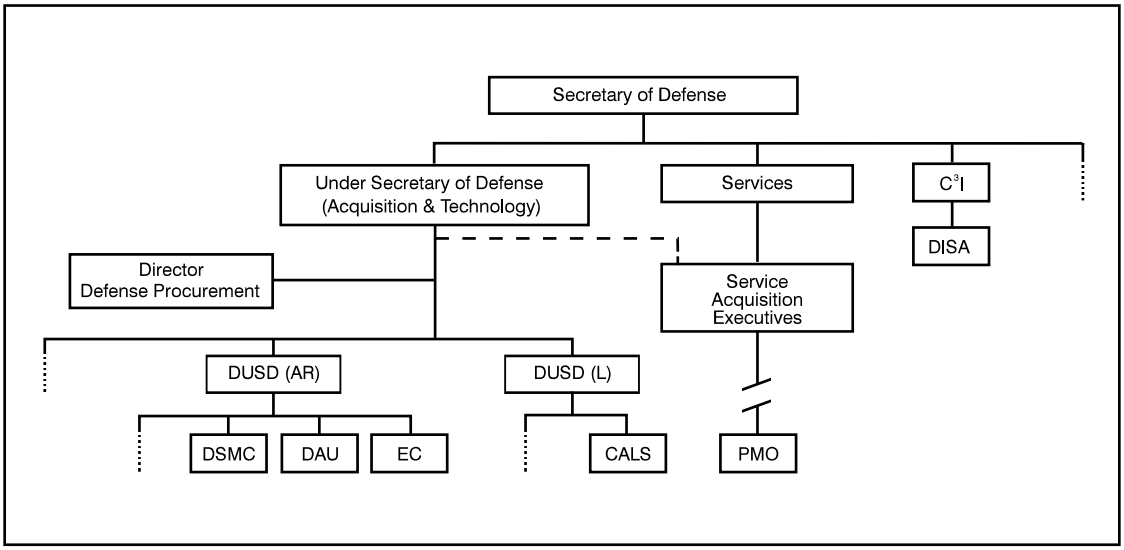

Figure 2-1. Major DoD Organizations Involved in the Digital Environment

- Coordinate the IDE framework within the DoD and to ensure integration of those requirements into DoD programs and processes.

- Participate with other government departments in an industry outreach program. Through that program, the CALS Office promotes a common shared information framework, compatible information infrastructures, and similarity of acquisition practices.[4]

In support of acquisition community efforts to further the IDE vision, the CALS Office has produced *The Program Manager's Desktop Guide for Continuous Acquisition and Life-Cycle Support (CALS) Implementation*, dated 29 September 1995.[5] This CD-ROM based package is a useful tool in developing an approach to the digital environment, particularly for new programs.

DoD Electronic Commerce (EC) Office

The DoD EC Office was established under the DUSD(AR) in 1994. The EC Office is responsible for facilitating the implementation of EC/EDI across all functional lines within DoD, and developed the *Introduction to Department of Defense Electronic Commerce: A Handbook for Business*, Version 2, dated June 1996. This is a useful source of EC/EDI information.

To date, the primary focus of the DoD EC Office has been to manage the implementation of EDI-based contracting systems within 244 DoD installations. These sites initiate 98 percent of DoD's small purchases. (Note: This is 98 percent of the number of transactions, not 98 percent of the dollar total.) When completed, this will enhance access by small businesses to small purchase Request for Quotes (RFQs) and assure that the Federal Government possesses the capability to support EDI-based procurements up to $100,000 in accordance with FASA. For the future, the EC office is actively pursuing the development of EDI applications that will enable additional business transactions beyond small purchases. Release of schedule and implementation guidance is expected in early FY 97.[6]

Director, Defense Procurement

As a Principle Deputy to the Under Secretary of Defense for Acquisition and Technology (USD(A&T)), the Office of the Director, Defense Procurement develops, interprets, and publishes procurement policy for DoD. This includes establishing requirements and guidelines that regulate the exploitation of digital environments, and playing an integral role in DoD Business Process Improvement initiatives. Defense Procurement sets policy for government rights to technical data, and develops standardized procurement data definitions and a standard procurement process.[7]

Defense Information Systems Agency (DISA)

Under the auspices of the Assistant Secretary of Defense (Command, Control, Communication, and Intelligence) (ASD(C3I)), DISA is responsible for promulgation of standards and primary support of the DII. With respect to the development of a digital environment, DISA's role can be categorized as follows:

> *The computer systems architecture will be developed in close coordination with Defense Information Systems Agency (DISA) and will be fully integrated with system migration planning to be ultimately realized via the DII. The objective of the architecture is to fully describe the communications and computer system infrastructure necessary to support the IDE and to develop the plan to efficiently migrate both the CALS Flagship systems and the remainder of the DoD computer systems infrastructure that supports the weapon system life-cycle to an IDE state. The computer systems architecture will include a systems specification that identifies the interfaces and performance standards necessary to meet the functional requirements of the weapon system support community.*[8]

The CALS Digital Standards Office at DISA is charged with overseeing CALS standards activities.[9] DISA is also responsible for providing information pertaining to the testing and certification of Value Added Networks (VAN), which support the DoD EDI effort.[10]

Defense Acquisition University / Defense Systems Management College (DAU/ DSMC)

The DAU is a consortium of DoD education and training institutions and organizations that provide mandatory and assignment specific acquisition courses for military and civilian personnel serving in acquisition career fields. Its mission is to educate and train professionals for effective service in the Defense acquisition process.[11] The premier consortium member responsible for training the acquisition community, notably PMs, is DSMC. With respect to the exploitation of a digital environment, education and training programs/courses within the acquisition community that touch upon this area are focused almost exclusively on specific functional applications (i.e. logistics, contracting, configuration management) and/or taught as functional electives. Programs that address "integrated" digital environments and cross functional use of information are being examined on a limited basis but are not currently in place.

National Institute of Standards and Technology (NIST)

An agency of the U.S. Department of Commerce's Technology Administration, NIST's primary mission is to promote U.S. economic growth by working with industry to

develop and apply technology, measurements, and standards. Although external to DoD, NIST plays an active role in the development of current and future standards and technologies that will be used throughout the acquisition process. In addition to addressing CALS functions and standards within their Enterprise Integration office, NIST plays a particularly active role in the development of business transaction standards that support EDI.

Industry Steering Group

The CALS Industry Steering Group (ISG) is a coalition of industry representatives working with CALS and the NIST Enterprise Integration Office. The ISG works closely with Trade Associations and both U.S. and foreign governments to promote CALS principles and formulate policies and outreach. Many within industry have begun re-defining the term CALS to mean Commerce at Light Speed, embracing more aspects of business processes, particularly EDI. A depiction is shown in Figure 2-2.

A significant effort, sponsored by the ISG, is the CALS EXPO, an annual international conference addressing CALS, EC/EDI, and Enterprise Integration issues. The ISG is structured by task groups, which are functional steering groups working on particular issues.

The National Technical Information Service (NTIS) provides distribution for ISG CALS information and makes available CALS EXPO Proceedings and reference books, attendee lists, meeting minutes, meeting announcements, tutorials, videotapes, and other information relating to CALS. In cooperation with the ISG, through the National Security Industrial Association (NSIA), NTIS also makes available the

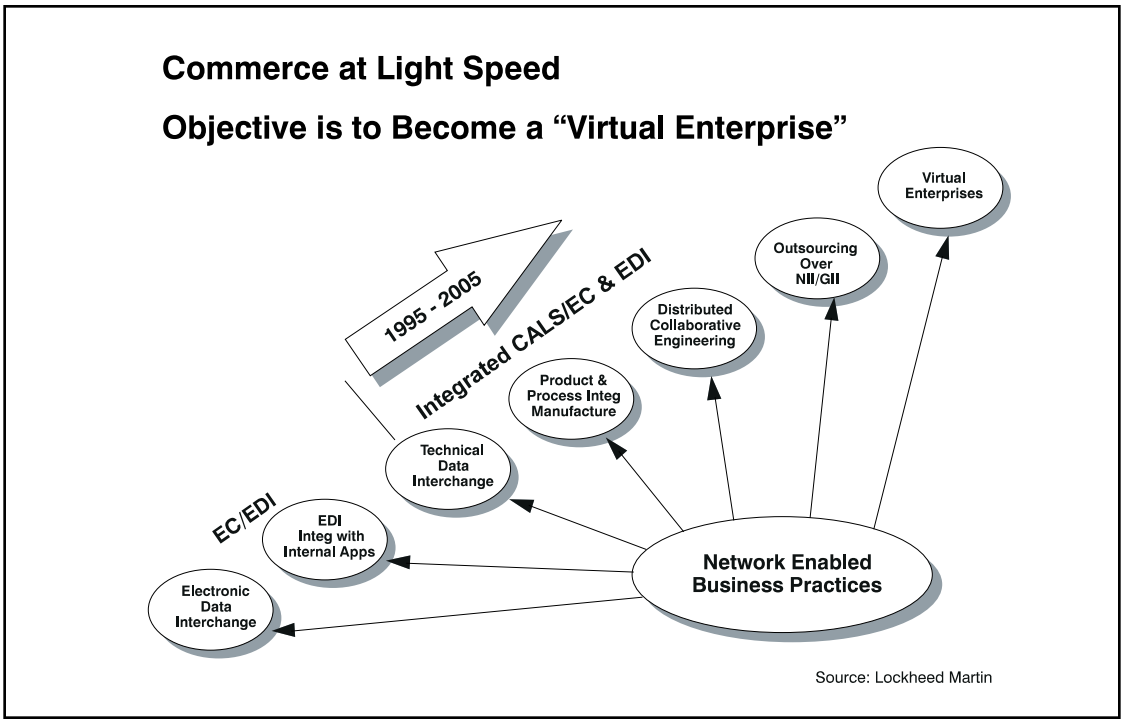

Figure 2-2. CALS: Commerce at Light Speed

Introduction to CALS Kit—a multimedia training package last released in September 1994.[12]

Electronic Commerce Resource Center (ECRC)

A significant source of information concerning EC/EDI and CALS initiatives nationwide are the ECRCs. There are currently 11 ECRC locations (see Figure 2-3) throughout the United States. The main focus of the ECRC is to provide education and outreach services to small businesses. However, they also provide generic training for a small fee to anyone interested in EC/EDI and CALS. Services provided by the ECRC's include:

- Providing regional information, training and consulting services, especially for small-to-medium-sized enterprises;
- Providing expert services and information to other providers in that nation-wide manufacturing extension network; and
- Developing critical information technologies to fill current gaps in information technology areas.

"In short, the mission of the ECRC program is to promote awareness and implementation of EC and related technologies into the U.S. integrated civil-military industrial base. The ECRC program consists of the National ECRC Technology Hub, ECRC Team Integrators, and Regional ECRCs."[13]

Definitions and Terms

In an effort covering the entire life cycle of weapon systems that has had three different titles in ten years, it is understandable that the terms and acronyms have not only changed but have come to mean different things to different stakeholders. This section will provide an overview of some of the major terms and initiatives that impact PMOs entering the digital environment. Appendix A provides an extended list of acronyms and terms that provide additional information.

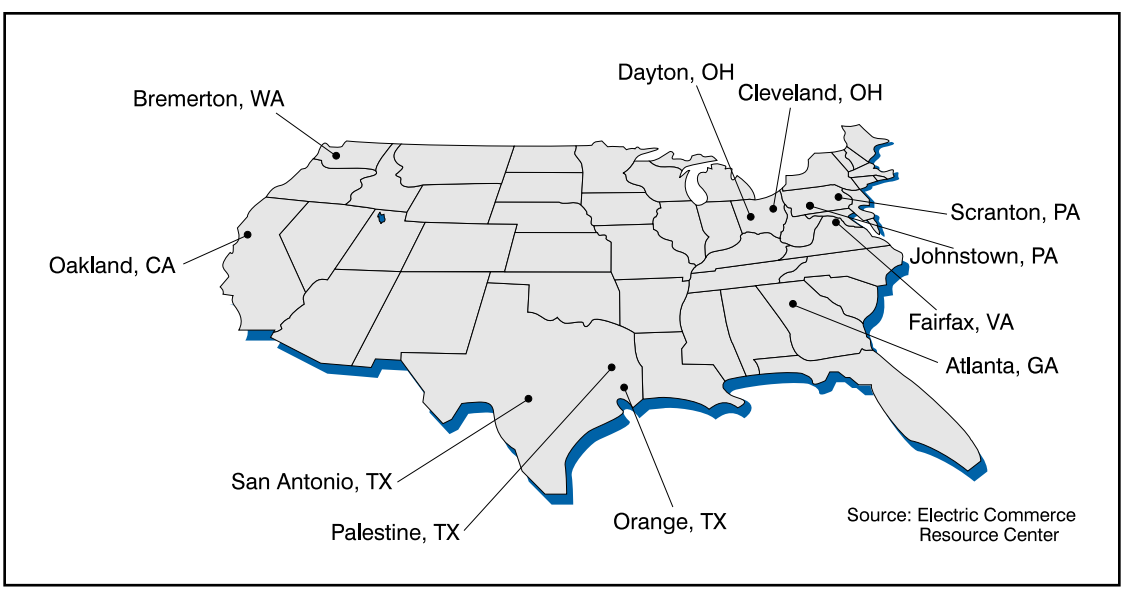

Figure 2-3. ECRC Locations

Continuous Acquisition and Life-Cycle Support (CALS)

CALS is a DoD and industry strategy to accelerate the pace at which high quality information flows within and between DoD and its business partners; while at the same time providing an opportunity to reduce information management overhead costs. CALS is defined as a core strategy to share integrated digital product data through a set of standards to achieve business efficiencies in business and operational mission areas. For more information on CALS Standards, see Appendix B.

According to the DoD CALS Office, DoD is committed to incorporating CALS into functional process improvements. As DoD applies the best technologies, processes, and standards for the development, management, exchange, and use of business and technical information among and within governmental and industrial enterprises, an IDE will be generated. DoD has developed this strategic plan to pursue it's IDE vision. It sets the following three goals for pursuing that vision:

- Expand its relationship with industry to ensure more harmonious methods of operation and seamless data exchange;
- Complete the transition of its active information and business transactions to electronic formats; and
- Integrate digital information across product life cycles.[14]

Integrated Data Environment (IDE)

The IDE is the business environment created by the application of existing national and international standards, practices, and technologies to automate the management and exchange of information (See Appendix B). The vision of this DoD-wide IDE is a boundaryless environment where all data are accessible to appropriately cleared personnel across all defense enterprises. The IDE enables integrated product and process development (IPPD) while increasing the agility and decreasing cycle times of the defense enterprise.

"The IDE represents the end state of the CALS vision in which technical and business data is [are] highly visible and accessible to all participants in life-cycle process execution. Current high quality business and product data is [are] generally available at its source of generation in digital form. Widespread use of such source data on an as needed basis transforms data from an overhead cost item to an enterprise asset. A communications and information management infrastructure provides the conduit in which the information flows from source to authorized user. In addition, functional information management services and other implementing processes are provided via the infrastructure [combination of the defense and commercially available communications and data processing infrastructures] on an as required basis. The collection of uncoupled users and sources of information supported by the infrastructure comprise the equivalent of a massive distributed database network facilitating enterprise-wide process improvements of high data intensity.

> *The IDE concept is driven by the pragmatic necessity to establish an information framework that will enable advanced business practices in the Defense Enterprise. Integrated Product and Process Development, Virtual Enterprises, Concurrent Engineering, Agile Manufacturing, Lean Logistics, Total Asset Visibility, et al., are all information intensive business practices that are not efficiently*

supported by today's AIS-centric [automated information system] information environment. The IDE is designed to introduce a new information environment founded upon the principle of wide ranging, cross-functional access to self-identifying product information.[15]

The goal of the IDE, as shown in Figure 2-4, may be best summarized as an integrated digital environment linking all stakeholders in the life cycle of a weapons system. Thus, allowing cross functional sharing of data that is created once and used throughout the entire life cycle of the system.

CALS/IDE Initiatives

As part of the CALS strategy the DoD is pursuing three infrastructure modernization programs with the goal of enabling the IDE.[16] They are Joint Computer-aided Acquisition and Logistics Support (JCALS), Joint Engineering Data Management Information Control System (JEDMICS) and Configuration Management Information System (CMIS). These three systems are being developed independently to work together in support of the DoD-wide IDE. The Army's Combat Mobility Systems (CMS) was the first program office to integrate these systems. This effort started in mid-1995 and was still underway in mid-1996. The CALS

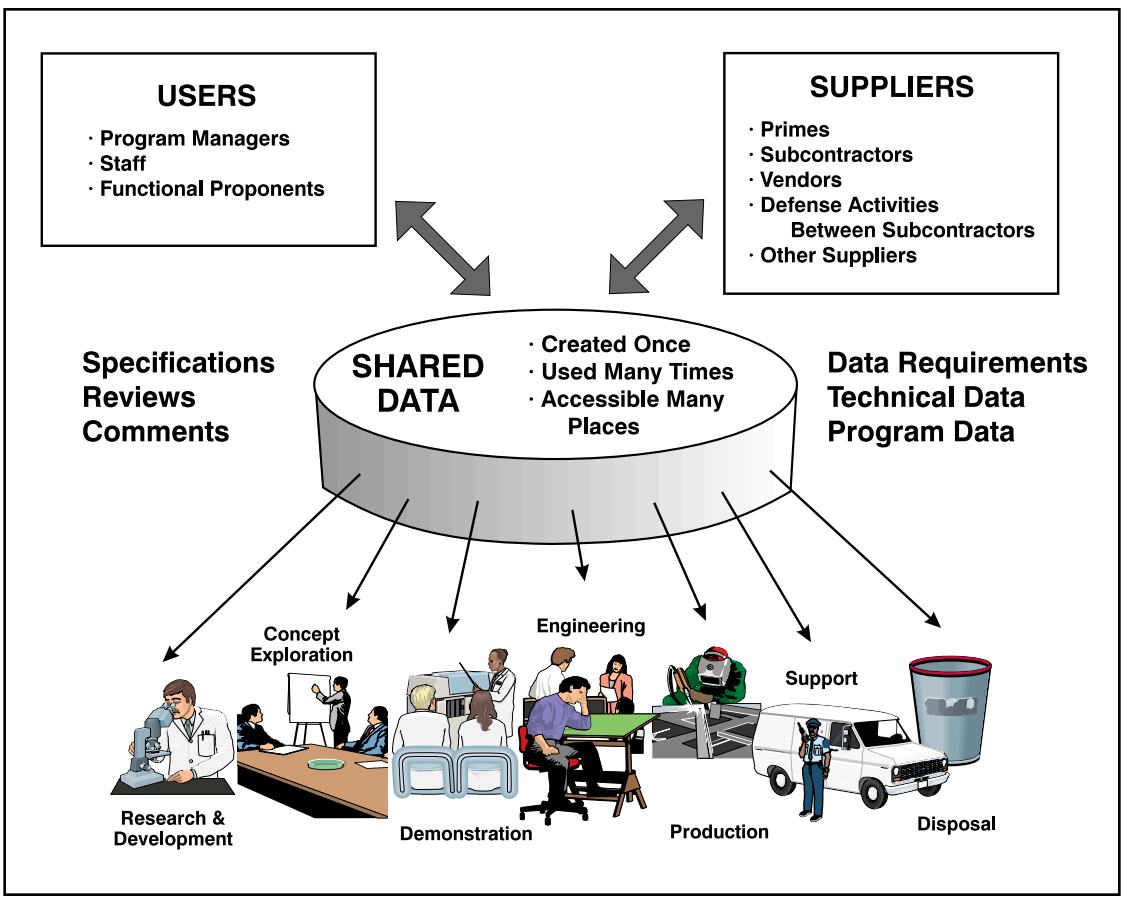

Figure 2-4. CALS Vision—Improve Product Life Cycle Information Management

Office has identified JCALS and JEDMICS as two of its "flagship programs."[17]

- **JCALS - The Joint Computer-aided Acquisition and Logistics Support**
  The JCALS program, an Army led initiative, is a key part of the CALS strategy. This program is intended to provide an Information Management System (IMS) to support uniform logistics, acquisition, engineering, management, and other life cycle functional processes. JCALS provides an infrastructure that supports a common and integrated organization and exchange of weapon system data throughout the entire life cycle. The system provides applications and services to implement cross functional processes. The goal of the JCALS program is to support more effective generation, exchange, management, and use of digital data. This enables the migration from manual, paper-intensive defense system operations to integrated, highly automated acquisition and support processes.[18]

- **JEDMICS - The Joint Engineering Data Management Information Control System**
  JEDMICS is a Navy led DoD program initiative for the management of approved engineering drawings and related technical data. The purpose of JEDMICS is to replace or supplement existing equipment at drawing repositories and technical libraries with an automated, state-of-the-art digital management system, thereby establishing a standard system for managing engineering and technical data in the Army, Navy, Air Force, and Defense Logistics Agency (DLA).[19]

- **CMIS - Configuration Management Information System**
  CMIS is being developed by the Joint Logistics Service Center (JLSC), which reports to DUSD(L). A DoD program software application, CMIS is designed to support configuration identification, change control, reporting, audits, and status accounting for weapon system programs. CMIS supports the life cycle baseline documentation and management of engineering designs and hardware. It tracks multiple baselines, establishes a functional baseline based on Hierarchical Structure Code by class, and tracks documents and part number information. Engineering documents, part numbers, and technical manuals/technical orders are cross referenced and accessed by the user from a single workstation.[20]

Electronic Commerce (EC)

The term EC is widely used by both the U.S. Government and industry. In industry the term EC is frequently used as the "umbrella term" to describe any digital exchange of information or data. Similarly, within DoD, EC is defined as the "paperless exchange of business information using Electronic Data Interchange (EDI), Electronic Mail (E-Mail), computer bulletin boards, FAX, Electronic Funds Transfer (EFT), and other similar technologies."[21]

Electronic Data Interchange (EDI)

EDI is the computer-to-computer exchange of business information using a public standard. EDI is a central part of EC because it enables organizations to exchange business information electronically and much faster, cheaper, and more accurately than is possible using a paper based system.

Who uses EDI? Currently about 50,000 private sector companies in the United States use EDI, such as Federal Express, Eastman Kodak, American Airlines, Nike, Staples, Nations-

Bank, JC Penney, and Prudential Insurance. EDI is widely used in manufacturing, shipping, warehousing, utilities, pharmaceuticals, construction, petroleum, metals, food processing, banking, insurance, retailing, government, health care, and textiles among other industries. According to a recent study, the number of companies using EDI is projected to quadruple within the next six years. The Government did not invent EC/EDI; it is merely taking advantage of an established technology that has been widely used in the private sector for the last few decades. ANSI X12 standards were developed to support EDI transactions for a wide variety of industry information applications.[22] (See Appendix C for a listing of ANSI X12 Version 3050 transaction sets.) ANSI X12 transaction sets are U.S. standards, although in the future ANSI X12 is expected to gradually align with an international set of EDI standards sponsored by the United Nations known as Electronic Data Interchange for Administration, Commerce, and Transportation (EDIFACT). Refer to Appendix B.

Federal Acquisition Computer Network (FACNET)

The FASA established the FACNET requiring the government to evolve its acquisition process from one driven by paperwork to an expedited process based on EDI. See Figure 2-5 for the FACNET process. The electronic system is intended to provide a *single face* to industry. FASA establishes parameters for FACNET both for Government and private users. These functions are to be implemented by agencies within 5 years of enactment of the Act. The Government-wide FACNET will be designed to:

- Inform the public about Federal contracting opportunities;
- Outline the details of government solicitations;
- Permit electronic submission of bids and proposals;
- Facilitate responses to questions about solicitations;
- Enhance the quality of data available about the acquisition process; and
- Be accessible to anyone with access to a personal computer and a modem.

Very simply, FASA raises the small purchase threshold to $100,000 and designates this as the *simplified acquisition threshold.* Procurement activities can use these new procedures when their activity is FACNET-certified.[23] Although FACNET is currently in use by over 200 DoD organizations and installations, there are other potential options. With the advent of the World Wide Web (WWW) some government activities, most notably NASA and DLA, have chosen to employ what they consider more open solutions than that presented by the FACNET.

Contractor Integrated Technical Information Service (CITIS)

CITIS is a contractor-developed and maintained service to provide electronic access and/or delivery of government-procured contractually required information (i.e., contract data requirements list (CDRL)). CITIS generally employs electronic networks for access and delivery of information and may include vendor and supplier data. It should be noted that CITIS is not the data itself or the database where it resides; CITIS is simply the service or mechanism that provides access to the data by authorized users. CITIS can be the back-

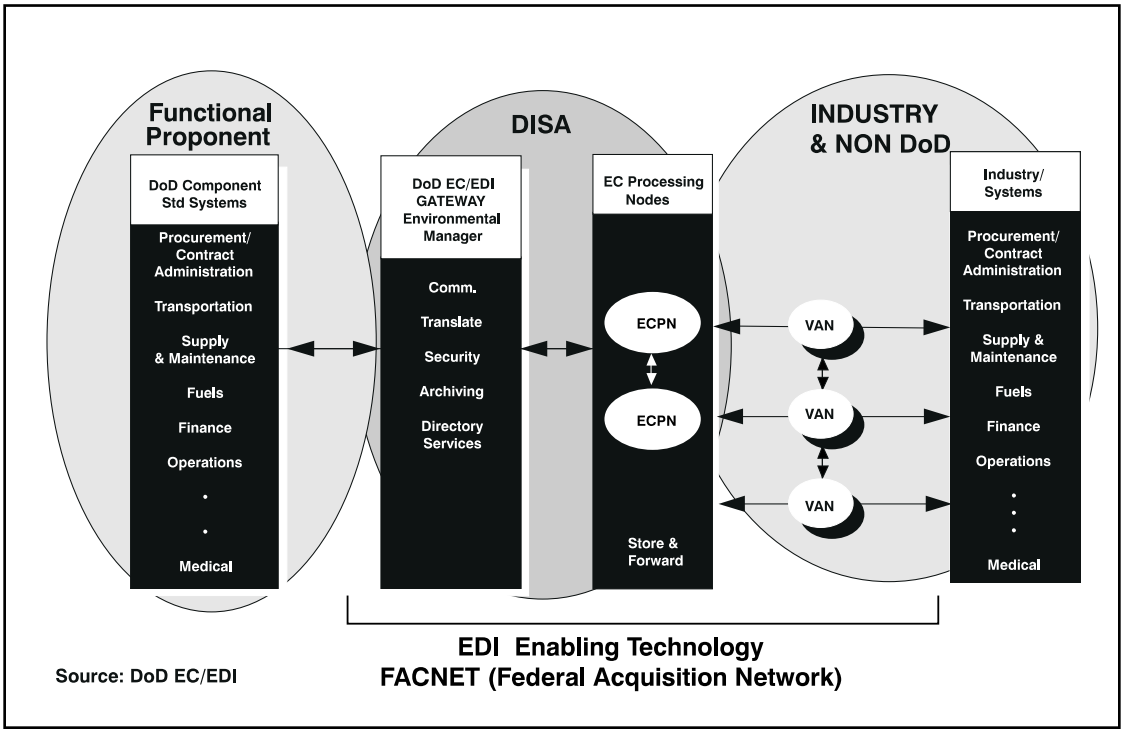

Figure 2-5. FACNET Architecture

bone of a PMO's integrated data environment, providing significant benefits to the PMO. It provides a single entry point for authorized government access to contractor-generated CDRL data and supports the philosophy of creating data once and using it many times. CITIS establishes a set of core information functions to facilitate the concept of "shared data," and standardizes functional characteristics of the data to facilitate usage by a wide variety of different users.

The primary advantages of using CITIS provide PMOs:

- Substantial reductions in the amount of data delivered and stored in paper format;
- Improved accuracy and timeliness of data;
- Improved management and tracking of review status;
- Reduction in review cycle time;
- Improved comment collection and correlation;
- Consistency of data used by all agencies/ activities;
- Readily accessible archive/repository of program data; and
- Opportunities to share data within the contractor's own enterprise, between the contractor and the Government, and between the Government's activities and locations.

The ultimate goal of CITIS is to reduce lead times and costs for weapons system design, manufacturing, and support processes, and at the same time assure technical information accuracy and timeliness. Figure 2-6[24] compares typical business practices with a program operation employing a CITIS.

CITIS supports the objectives of DoD 5000.2-R, paragraph 3.3.4.5, dated March 15, 1996: "Beginning in FY97, all new contracts shall require on-line access to, or delivery of, their programmatic and technical data in digital form, unless analysis shows that life cycle time or life cycle costs would be increased by doing so. Preference shall be given to on-line access to contractor developed data through contractor information services rather than data delivery. No ongoing contract, including negotiated or priced options, shall be renegotiated solely to require the use of digital data, unless analysis shows that life cycle costs would be reduced."[25]

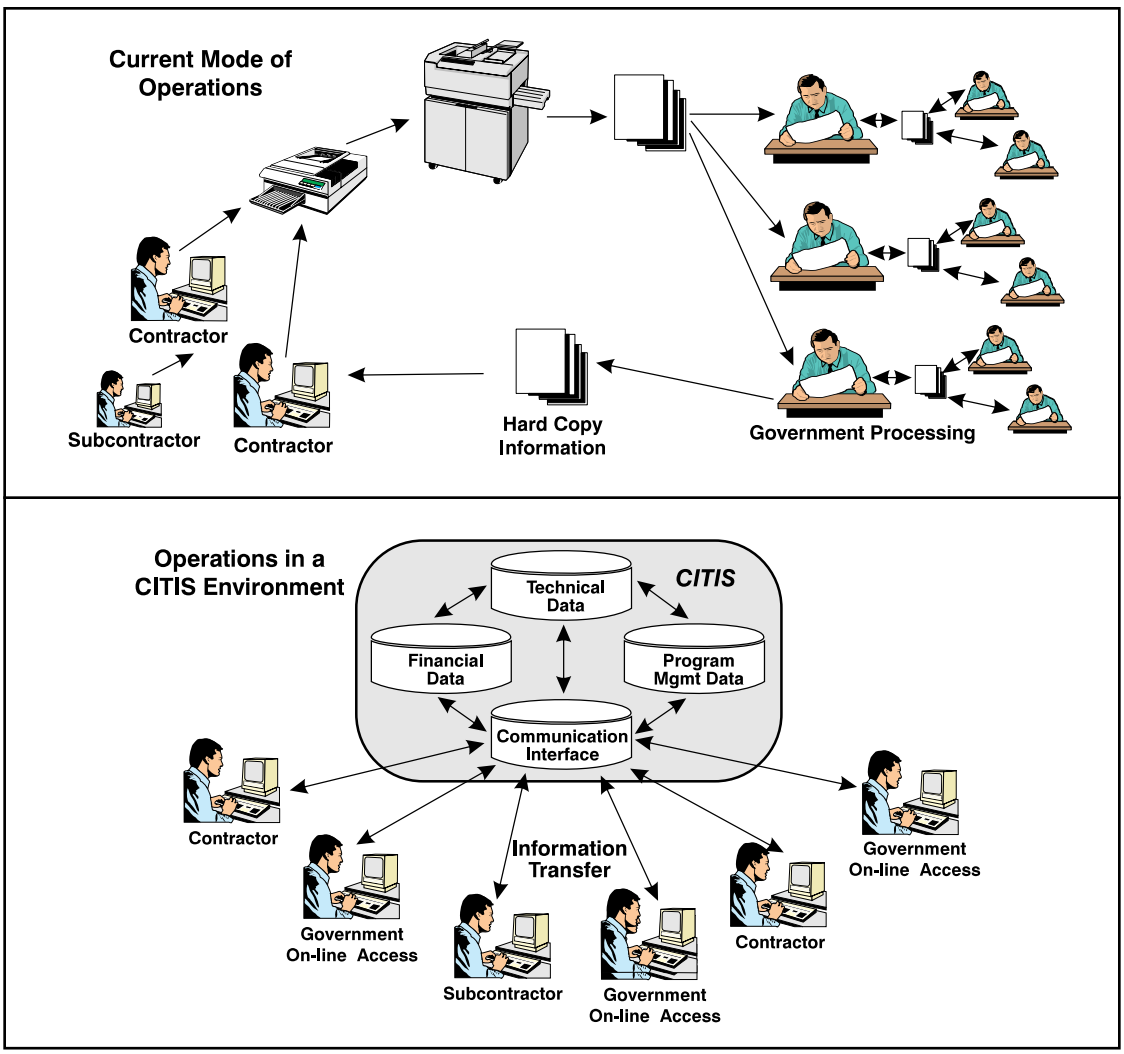

Figure 2-6. Current Operating Environment vs CITIS Environment

Workflow Manager

A workflow manager is a software application designed to increase productivity. Using customized rules or knowledge based processing, workflow managers enhance operations by automatically managing:

- Single point of administration and maintenance;
- Assignment of tasks (personal and group);
- Automatic initiation of actions;
- Coordination, timing, and sequencing of events;
- Notification, suspenses, and e-mail based reminders;
- Work in progress reports (project and process status);
- Continuous quality control (data integrity); and
- Data rights and access.

A workflow manager can be a key functional component of an integrated digital environment, helping organizations achieve greater efficiency through near real time collaboration despite geographic and functional separation. By its design, workflow managers go beyond e-mail by permitting greater flexibility through parallel processing, quicker access to the right data by the right people at the right time, and providing a coordinated and integrated decision making environment. See Figure 2-7.

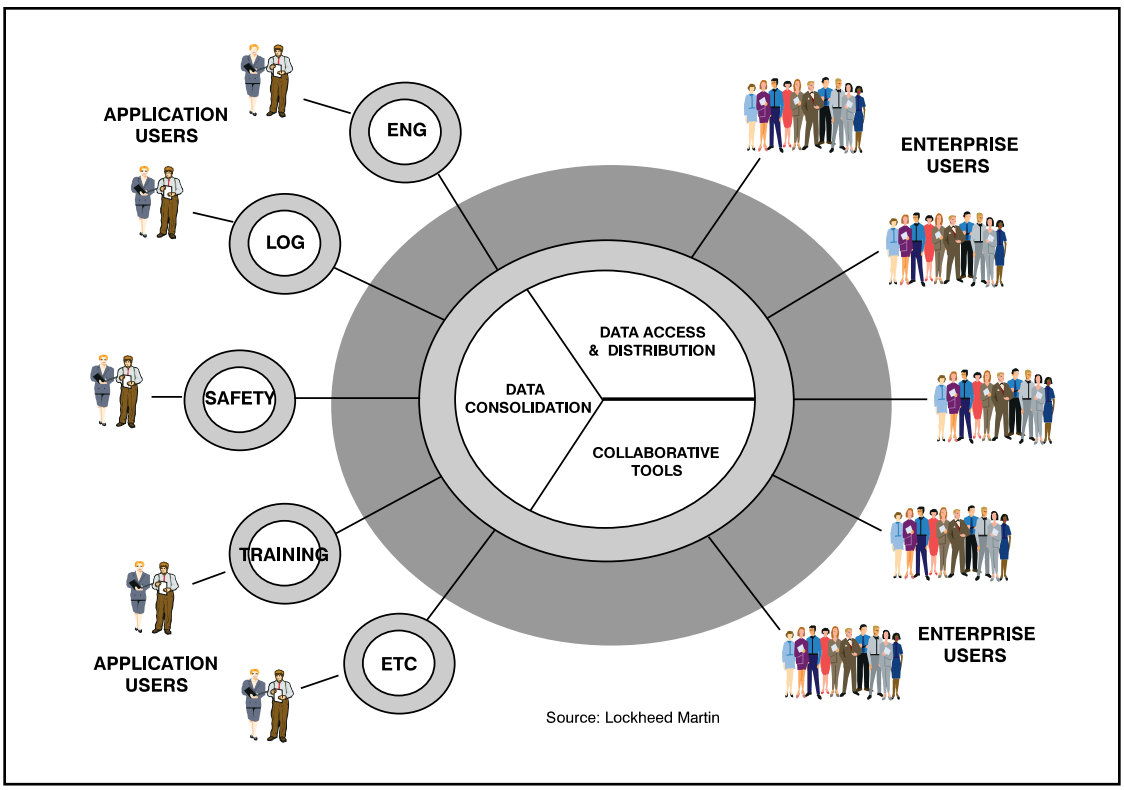

Figure 2-7. Collaborative Work Environment

Acquisition Program's Digital Environment (APDE)

In this research report, the researchers develop the concept of an APDE, see Figure 2-8. Defined as a cross functional integrated digital environment linking the entire acquisition program team, the APDE is a realizable, program specific subset of the DoD-wide IDE vision. The primary difference between the two is that an APDE focuses on an individual acquisition program, and its development is within the span of control of the PM. APDE supports program specific requirements and enables process improvements, increases in efficiency, and reengineering efforts that are achievable by both the PMO and Government-industry acquisition partners.

An APDE can range in complexity from the very simple to the very complex. At the low end, key people may share e-mail and limited information sets within the PMO and/or with the prime contractor, perhaps incorporating commercial software to facilitate data access. At the high end, an extensive digital infrastructure enables every active participant to have direct access to all pertinent data relating to one's function or process, regardless of the physical location of the database. These active participants include not only the PMO and prime contractor personnel, but also sub-contractors, vendors, suppliers, support agencies, and end users. Figure 2-8 depicts elements that comprise an APDE. What is right for your particular PMO is a point somewhere along this continuum. As with the IDE, the use of standards to support data exchange and interoperability are essential to an APDE.

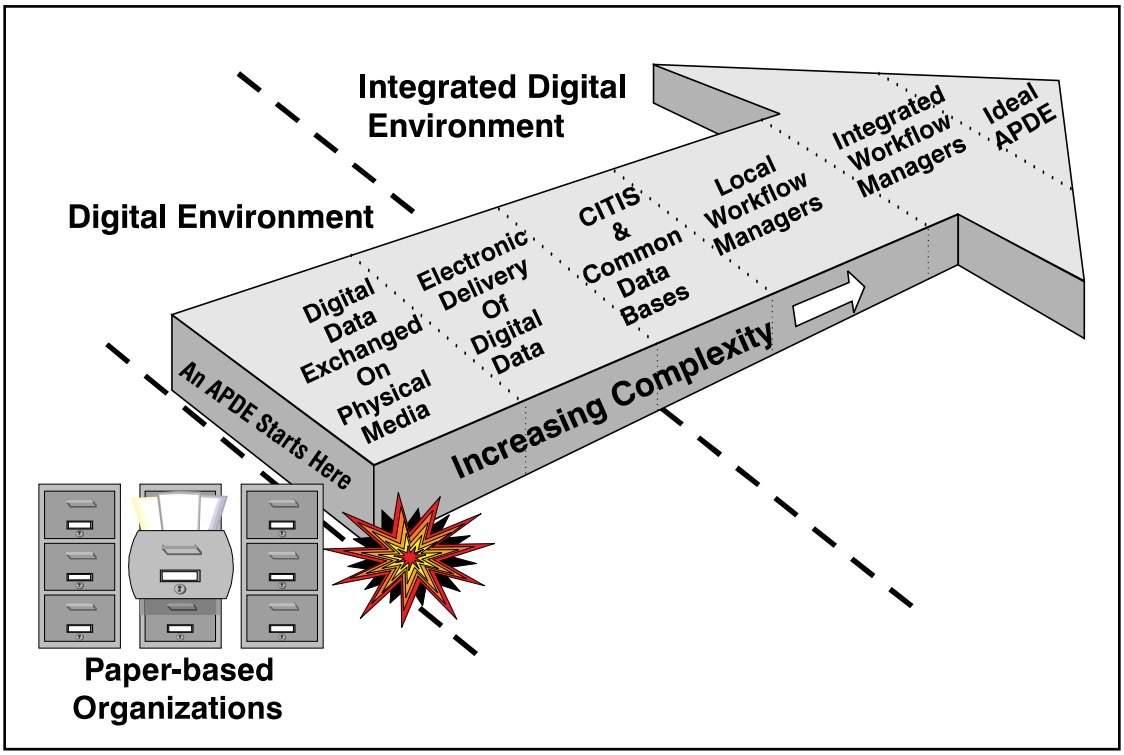

Figure 2-8. APDE Model

The APDE model is not meant to imply a required order of implementation. Lower level elements, such as CITIS, are not necessarily prerequisites of higher level elements. As the degree of complexity moves from simple digital delivery of data to shared data access, the APDE moves into an integrated digital environment. The APDE recognizes that the digital infrastructure will be an evolving set of digital environments that mature as a program transitions from concept exploration through design, production, fielding and finally disposal. This environment will have different characteristics over time in terms of infrastructure, users, processes, and access requirements. During early design phases the environment is characterized as highly dynamic, design trades are underway, and users are few with involvement in computationally intensive activities. This is in contrast to the post production portion of the life cycle when the design is largely fixed but there are a large number of users who need access to mature program information. In Figure 2-9 all the stakeholders would be linked to each of the environments; however, the principal users change as a function of the program life cycle. *It must be emphasized that throughout the life cycle all players must be involved; it is only the focus and the dynamic nature of the environment that changes*.

Summary

Moving into the information age and exploiting the potential of integrated digital environments is key to the future success of the acquisition community. However, as it necessitates crossing functional, organizational, and process

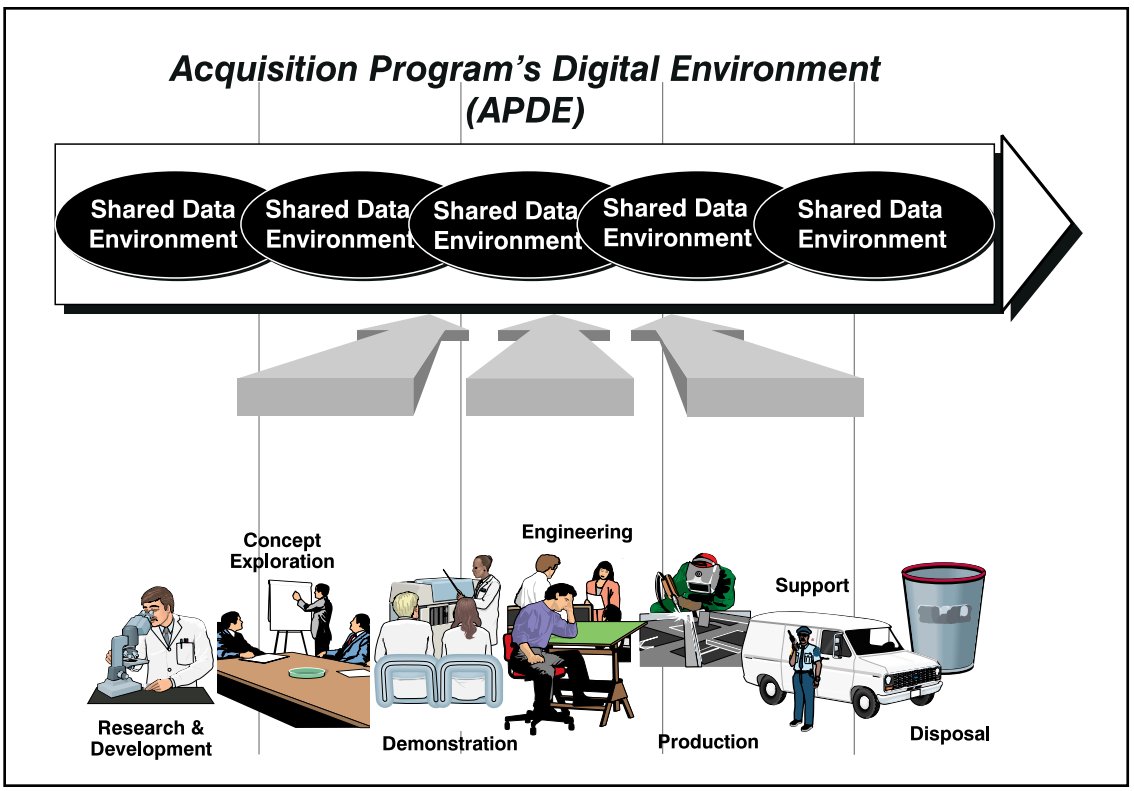

Figure 2-9. APDE Evolutionary Process

boundaries, it has far reaching implications that impact DoD, the U.S. Government, industry, and even the international community. The Defense Acquisition Community must at least be aware of these factors and attempt to take advantage of opportunities that they present. There are many organizations that play an active role, along with numerous ongoing and overlapping initiatives. In some cases, ongoing efforts are beyond the control of the PM. However, there is still much that can be done. For this reason, the APDE was developed. It provides a framework that recognizes the disparate nature of digital environment initiatives, yet enables the PMO and industry partners to capitalize on the advantages that such initiatives offer.

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22. Ibid.

23. Ibid., p 11.

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3

WHY TRANSITION TO A DIGITAL ENVIRONMENT

The purpose of this chapter is to examine why Program Managers (PMs) should develop and employ integrated digital environments within their acquisition programs. Exploitation of the information age has been the key to many recent successes within the business community, and offers as much potential for the Department of Defense (DoD).

There are two distinct, and somewhat overlapping, reasons for the PM to transition from a paper intensive environment to a digital environment. The first is DoD policy requires movement away from paper-based processes as quickly as possible. As noted in Chapter 2, DoD Regulation 5000.2-R requires all new contracts (starting in FY97) to require on-line access to, or delivery of, their programmatic and technical data in digital form. A more compelling reason—it simply makes good business sense. There is a need for fundamental and radical changes in the DoD acquisition process. Responding to this need, the position of Deputy Under Secretary of Defense (Acquisition Reform) (DUSD(AR)) was created. This office was established "...to be a focal point and catalyst for the development of a coherent practical step-by-step plan to reengineer the acquisition process...."[1] The objectives of reengineering are to achieve substantial cost reductions, decrease cycle time, increase efficiency, and provide higher quality. In short, we need to do our jobs faster, better, smarter, and cheaper. Our research has found that an integrated digital environment (i.e., Acquisition Program's Digital Environment (APDE)) is a necessary precondition to achieving the goals of Acquisition Reform, in general, and reengineering in particular.

Need for Reengineering

The need for reengineering the DoD acquisition process has been well documented. At a time when acquisition budgets have declined by 60 percent in real terms in the last 10 years, DoD can no longer afford a process that results in unique requirements with significantly higher cost and longer design cycles. Design cycles for DoD-related systems are almost twice that of commercial systems.[2] This means that in some areas new systems are verging on technical obsolescence when they are fielded. The added cost of the acquisition process is of equal concern. Overhead, or management and control costs, associated with the DoD acqui-

sition process are about 40 percent of the DoD acquisition budget, as compared to 5 to 15 percent for commercial firms.[3] The cost of the DoD's regulatory maze has been estimated at 15 to 75 billion dollars.[4] Other studies have indicated that DoD contractors incur additional costs on government contracts of about 30 percent over their commercial counterparts for identical items/services.[5]

A key element in DoD's attempt to reengineer the acquisition process is the use of Integrated Product Teams (IPTs) and Integrated Product and Process Development (IPPD) concepts. As DoD 5000.2-R states:

> *The PM shall employ the concept of Integrated Product and Process Development (IPPD) throughout the program design process to the maximum extent practicable. The use of Integrated Product Teams (IPTs) is a key tenet of IPPD.*
>
> *The IPPD management process shall integrate all activities from product concept through production and field support, using multidisciplinary teams to simultaneously optimize the product and its manufacturing and supportability to meet cost and performance objectives. It is critical that the processes used to manage, develop, manufacture, verify, test, deploy, operate, support, train people, and eventually dispose of the system be considered during program design.*[6]

Although IPT and IPPD guidance is primarily focused on internal DoD activities and reviews, the need to reengineer the process extends well beyond internal DoD-level activities. The PM must not fail to embrace the entire acquisition team, to include industry stakeholders and acquisition partners, if DoD is to fully realize the benefits of reengineering.

IPPD Successes

This is one area where defense acquisition programs can learn from industry. Many of the recent "success stories" in the media concerning improvement in competitiveness of American firms can be traced to the aggressive use of digital environments and the creation of an IPPD environment. During a recent speech, the Under Secretary of Defense (Acquisition and Technology) (USD(A&T)) highlighted two commercial programs and the benefits that an IPPD environment created:

> *The first is Boeing's use of Computer Aided Three-dimensiona Interactive Applications—CATIA software—for the development of the 777 aircraft. Boeing's management made the decision to change the culture of the company and invest $100 million in a computer aided development capability. The bigger "investment" was in the total corporate commitment to this approach...there was no fall back approach in place.*
>
> *As a result, there is no physical mock up for an aircraft with 85,000 components and over four million parts. The goal is to achieve the same number of manufacturing hours as the 767—for an aircraft with 57 percent greater empty weight—by reducing the number of design changes to at least one-half of that experienced on the 767. To date, Boeing is reporting a 93 percent reduction in the number of design changes.*
>
> *My second example illustrates the point that computer assisted integrated product development is not just for large corporations. In this case, Kohler's Engine Division is a producer of small 5 to 25 horsepower 4-cycle lawn mower engines.*

This company is a small player in a big field. The business strategy is fairly straight-forward—sell engines by offering superior performance and high reliability at a lower cost.

Kohler has been using state-of-the-art CAD/CAM [computer-aided design/computer-aided manufacturing] tools to introduce new designs that are radically different from earlier versions—quite a departure from the evolutionary change approach traditionally practiced by this industry. At Kohler, manufacturing cycle times have been cut by two years. Physical prototypes are no longer necessary. Kohler offers a 2-year warranty—the longest in the industry.

As a result, John Deere selected Kohler for its line of lawn mowers instead of the previous supplier—Kawasaki. Kohler's market share has continued to grow significantly over the past several years. My point is that the technologies for integrated product development, virtual prototypes, and modeling and simulation are widespread and available to smaller corporations. If correctly managed, transition costs should not present an insurmountable entry barrier to smaller, moderate sized corporations.

Another conclusion I draw from these two examples is that world-class producers across both ends of the manufacturing spectrum—from 777 aircraft to 25 horsepower lawn mower engines—are being driven by market forces and are finding a way to reduce the cost of fielding increasingly complex systems.[7]

Market forces drove the search for better, smarter ways to do business. These forces have been responsible for dramatic shifts in the way many commercial firms conduct business and are organized. Open competition and a market economy have fundamentally altered the structure of many American businesses. These businesses were faced with the alternatives of radical change or extinction. Since DoD acquisition programs are not directly faced with either competition or market forces, they tend to lag behind commercial activities in the way business is conducted.

In these examples, both companies implemented the commercial equivalent of an APDE to exploit an IPPD environment. In the Kohler example it was relatively limited and centered on internal engineering and production activities. The CAD/CAM system allowed cross functional integration of engineering and manufacturing and the development of an internal IPPD. The level of integration represented by the Boeing 777 effort was extremely high, linking design, manufacturing, and support activities of numerous companies located around the world. This was a global scale IPPD. Both companies generated an important competitive advantage and realized significant improvements in efficiency and quality, and reductions in both cycle time and cost. This was made possible through the use of an APDE. The traditional use of prototypes to ensure form, fit, and producability were obviated by the APDE's ability to enable a truly concurrent engineering and development process. This radical improvement in program performance is a clear example of why PMs should embrace the APDE.

Change in Organizational Structures Needed

The basic organizational structure used by most businesses and the DoD have historically been hierarchical in nature. Their design, manage-

ment techniques, and operational philosophies trace their origins to Adam Smith and the publishing of *Wealth of Nations* in 1776. *Wealth of Nations* became a cornerstone for management practices in the industrial age. In his book, *Rebirth of the Corporation*, D. Quinn Mills points out that one of the origins of the hierarchical organization was a lack of communications technology that led to the need for a limited span of control. He also points out that "a hierarchy is handicapped in exploiting new communications and computer technology because its vertical reporting and functional divisions inhibit networking."[8] The industrial age bureaucracy was based on the premise that a limited span of control was required and the limited span of control was necessitated by a limited communications ability.

Currently, DoD is attempting to use management techniques and philosophies from the industrial age in the information age. Industrial age bureaucracies are based on:

- Specialization, which led to economies of scale, as the most efficient way to produce products;
- Rigid lines of authority and reporting;
- Creation of rules or practices to address every contingency, if possible;
- Extensive paperwork to document that appropriate actions occurred;
- Detailed design and "how-to" specifications as the only way to ensure an acceptable product, and to ensure a "level" playing field for competition;
- In-process inspections, audits, and reviews as the most effective means to assure compliance with the system; and
- Programming people to conform to established procedures ensured that systems would be predictable, workable, and safe.[9]

In *Reengineering the Corporation: A Manifesto for Business Revolution*[10] Michael Hammer and James Champy make the point that we must transition from the industrial age practice of breaking down work into the simplest tasks, to the information age where tasks are built into processes. The industrial age task orientation leads to exceptionally fragmented and complex organizations with multiple functional *stove pipes.* The *stove pipes* lead to numerous impediments of information flow and result in an error prone organization where significant delays occur and no one is accountable. The solution to this problem is reengineering.

Reengineering and the APDE

The creation of an integrated digital environment is fundamental to the successful transition from the industrial age to the information age. One of the key benefits in a digital environment is the ability to communicate horizontally as well as vertically. This transformation in how communication flows is at the heart of the information age. By dismantling the *stove pipes*, organizations begin to move into a new environment that allows significant improvements in all aspects of the acquisition process. In order to meet the needs of the warfighter, the DoD acquisition process must move forward into the information age: leaving behind the fragmented stove pipe organizations of the industrial age.

Hammer and Champy offer several examples of radical improvement in performance through reengineering. In all cases an integrated digital environment was a necessary precondition for success; "In reengineering, information technology acts as an *essential enabler*."[11] Two

of the many examples cited by Hammer and Champy are Kodak—who reengineered its product development process, and Ford Motor Company—who reengineered its accounts payable department.

Kodak went from an organization based on serial design and development process to one utilizing integrated, parallel processes. Through the use of an integrated product design database Kodak moved into a concurrent engineering setting. Establishing an integrated product design database allowed immediate insight into the overall effort and ensured that potential problems were detected and remedied early and not during production or final design review. By linking various engineering functions and manufacturing into a common database this effort reduced the concept-to-production cycle time from 70 weeks to 38 weeks (almost 50 percent). An additional benefit was the ability to get the manufacturing and tooling engineers involved earlier which led to a reduction in tooling and manufacturing costs of 25 percent.

Ford Motor company was able to reengineer its entire procurement process using a process oriented digital environment to replace a paper-based system. The net result of this effort was a reduction in the accounts payable department from 500 to 125 personnel. Ford used the power of an integrated environment to achieve a radical reduction in manpower not by automating the existing payment system, but by reengineering the entire procurement process. Instead of a system where accounts due were paid only after receiving documentation, reconciling purchase orders, and processing final invoices; Ford developed a system that did away with invoices entirely. In the new system, when a purchase order is issued the order is entered into an on-line database that is used to match goods received at the receiving dock with goods ordered. If the items received match the database, the system automatically generates payment. If they do not match, they are returned to the vendor. By establishing an integrated digital environment linking purchasing and receiving, Ford is able to drastically reduce the role of the accounts payable department. Ford required digital technology to enable this radical improvement in the procurement process.

A key aspect of the examples used thus far is not the use of technology in and of itself, but rather the use of technology to move from the hierarchical, industrial age organization to a process-oriented information age organization. That is the key to reengineering—leaving behind the vertical stove pipes of the past. Even without reengineering the PM can take advantage of the digital environment to move from serial to parallel processing. An APDE can be established within the existing organizational structure. However, radical improvements in efficiencies will only occur if development of an APDE is accompanied by organizational changes that take advantage of its inherent capabilities. Establishing an APDE with no changes to the organizational structure may actually be counter-productive. One major acquisition program that implemented a Contractor Integrated Technical Information System (CITIS) environment is a case in point. Although all drawings and contract data requirements lists (CDRLs) were available on-line, the government still required paper delivery of originals and maintained a paper-based configuration management system in parallel to the contractors integrated digital design database. In addition, all documents that required government approval had to be submitted in paper for routing through the government approval chain (serial processing in a paper-based organizational structure). Clearly, the organizational structure was not modified to take advantage of the ADPE's inherent capabilities.

Another example involves the circuit breaker division of General Electric (GE).[12] The division had set a goal of 3-days from receipt of order to delivery instead of the normal 3-weeks. GE used what amounted to a two-stage approach. In stage one, GE developed an automated system that allowed a salesperson to input an order into a computer system, the order then was transferred to the production plant where it was automatically programmed into production. This use of technology saved an entire week (leaving GE 11 days short of its goal). As part of this effort GE consolidated six production facilities into one, and developed an automated design system to replace a custom design process. Changing the design process alone reduced the number of parts from 28,000 to 1,200—a factor of almost 24.

Removing the remaining 11 days required what is classically known as reengineering. In the second stage, GE exploited its digital environment, reengineering the production process, reducing worker to management organizational layers from three to one, and removing all line supervisors and quality inspectors. The 129 floor workers were divided into teams of 15 to 20 members. These teams assumed many of the traditional roles of middle management such as quality control, vacation scheduling, and work rule decisions. The net improvements at GE were dramatic. Not only did they reduce the cycle time from 3 weeks to 3 days; but productivity increased 20 percent, while manufacturing costs decreased 30 percent.

The APDE and DoD

In DoD acquisition programs, roughly 80 percent of the total life cycle costs of weapon systems are fixed in the first 20 percent of the program. Figure 3-1 shows this relationship. The

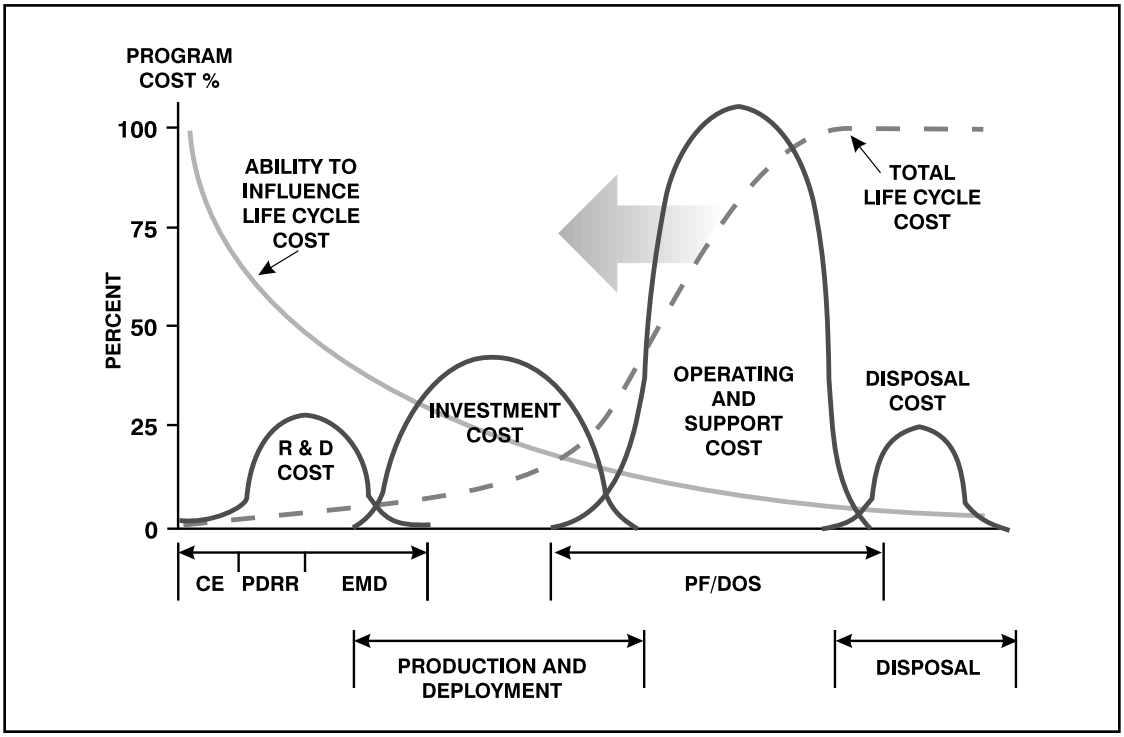

Figure 3-1. Life Cycle Cost vs Program Phase

PM should focus on reducing total life cycle costs early in the development process. The APDE directly enables this to occur by allowing the PM to create an IPPD environment to ensure that all stakeholders are involved, identify data and process requirements up front, and thereby plan for reducing long-term costs.

More importantly, an APDE is central to improvements in the following areas:

- Cost Savings;
- Reduction in cycle time;
- Better life cycle support;
- Increased process and product coordination;
- Better data quality;
- Greater data access; and
- More timely decisions and improved decision making.

In industry, an integrated digital environment provides a key for improving competitive advantage and increasing profits. For the DoD acquisition manager, an APDE is essential if PMOs are to achieve the goals and objectives of acquisition reform. The transition to a digital environment is not an option. The key question becomes what level of an integrated APDE is appropriate for each program. Although there is a lack of DoD acquisition program examples to use in deciding what is appropriate for each program, the results from industry are compelling. It is clear from both commercial experience and Defense policy that the Defense Acquisition Community must begin the transition if they are to indeed operate faster, better, smarter, and cheaper.

Summary

This chapter presented a wide array of industry examples ranging from commercial aircraft to circuit breakers to lawn mower engines. In each case, dramatic improvements in efficiency and program performance were a direct result of developing and exploiting an integrated digital environment. DoD acquisition programs must attempt to make similar transitions if they hope to mirror the process improvement and reengineering successes of industry. For the PM this translates into the need to develop an APDE. Capitalizing on the information age is of fundamental importance if the acquisition community is to provide the warfighters with quality systems and desired quantities in light of reduced or limited funding.

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4

WHAT IS HAPPENING IN THE FIELD

Introduction

This chapter discusses what we discovered in our research regarding the development and implementation of digital environments. Over one hundred interviews were conducted at more than thirty sites. Site observations highlighted a few obstacles that slow an organization's evolution of an Acquisition Program's Digital Environment (APDE) and a few key characteristics that help others gain momentum along the APDE continuum.

There is no universal APDE standard or *truth* among the organizations examined. There are just too many implementation options available. As one expert in industry so fittingly stated, "there is no silver bullet single solution.... it requires a major investment which is difficult to find when the attention is on reducing overhead costs in a downsizing environment."[1] Because an APDE-like concept is relatively new and evolving, an understanding of the context of why and how organizations create them is essential. Our research further investigated barriers encountered in adopting an APDE. Not surprisingly, the researchers noticed a wide-range of reasons, both supporting and limiting APDE development.

Obstacles

Understanding the Requirements

Even though organizations are conducting business using digital technology, very few of those interviewed possess a coherent game plan that outlines the requirements and objectives for integrating digital environments. The knowledge level of particular software packages like e-mail (considered the *life blood* by some organizations), word processors, spreadsheets, and their respective benefits to individuals are high; *understanding how to integrate digital environments across functional areas and processes are low*. Few organizations know of, or construct, a concept of operations that address what data they need, why, when, where, how, and for how long. Instead, most organizations tend to specify short-term data requirements without linking the information environments for the long run.

Quite a few organizations mimicked what one major defense contractor called "islands of

databases." The norm appears to be a multiple collection of unique databases tailored for specific departments responding to specific customers who want to share information between two points, electronically. Some databases have duplicative functions; others possess little growth potential; and some have limited interoperability. In one case, an organization was still hesitating over what type of digital environment to employ after spending over a half million dollars on a system that did not work.[2] In another instance, both a Program Management Office (PMO) and its prime contractor maintain identical technical drawing databases. The PMO's database is the official one. Ironically, the one most used is the contractor's because it is more current.[3]

There are many misconceptions regarding the need and general employment of an integrated digital environment. Only a limited number of the sites visited appreciate what integrated digital environments offer, what constitutes one, and what initiatives are available to help their organization develop one best suited to meet their needs. Interestingly enough, most organizations who did recognize the need are not cognizant of any guidance to help them construct one. Organizations feel they are on their own and tend to reinvent the wheel.

Learning Curve

Another obstacle limiting the understanding of APDE-like systems has been the slow migration of certain enabling digital technologies within the ranks, selling its usefulness, believing in its cost savings, and breaking cultural barriers. There are many personnel, especially at the senior level, who do not feel comfortable with digital technology nor appreciate the impact it might have on improving or streamlining their organization's fundamental processes. According to CAPT (USN) Joe Dyer, F/A-18 PM, people are becoming more comfortable with information technology, the cornerstone to making an APDE work, and time is helping more than anything else.[4]

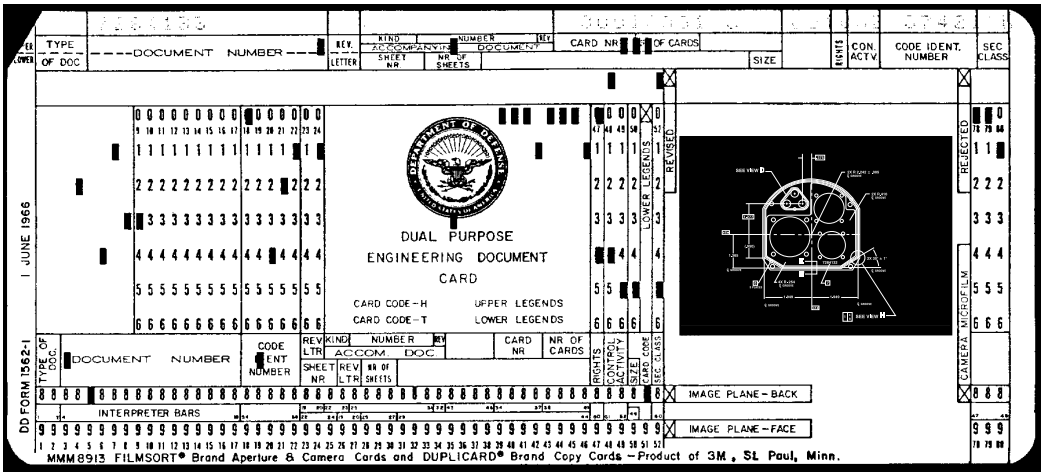
Security Concerns

In some cases, there is resistance to move further into an APDE despite savings perceptions because of security concerns. Not unlike most organizations, the V-22's joint contractor teams' original concern involved the protection of proprietary data and initially insisted that information not be passed over the Internet.[5] Security is and will continue to be a concern. It is believed that the military's computers are probed by outsiders close to 500 times a day, via password sniffers, spoofers, and holes in the web.[6] However, research shows most organizations overcome these concerns by possessing either organic security experts or by hiring outside specialists who understand the regulations and standards, recognize the threat, and can implement the appropriate safeguards without creating interoperability problems.

Paper-Based and Bureaucratic Processes

Another area which organizations find difficult to overcome is the reliance on paper-based processes, especially within the Department of Defense (DoD). Several defense contractors are still delivering aperture cards—design drawings captured on microfiche, see Figure 4-1—to the field sustainment activities because the sustainment community does not possess the infrastructure to support digital processing.

In one case, a defense contractor establishing a digital design environment was asked to convert their digital drawings to aperture cards—which the sustainment community now scans back into digital drawings (with less resolu-



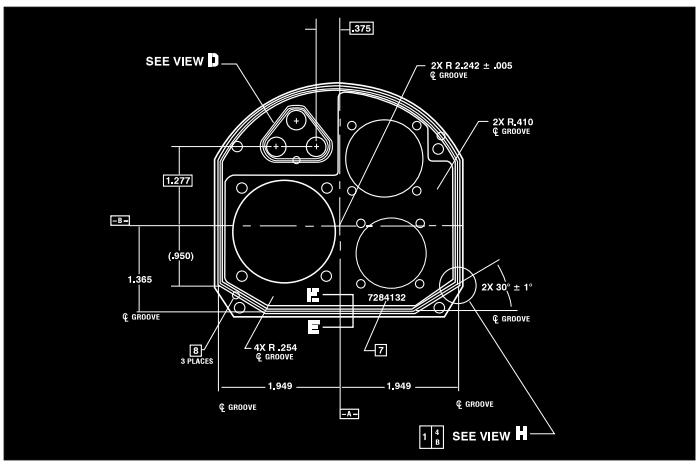


Figure 4-1. Sample Aperture Card

tion). In another case, a major PMO receives most of its data digitally, but also requests paper copies for all the drawings requiring coordination and approval.

Mr. Norman R. Augustine, President and Chief Executive Officer, Lockheed Martin Corporation, recently highlighted a classic example of the over burdening paper bureaucracy that creates a certain frustration for industries who do, or did, business with the government. When he operated the company's astronautics business (then Martin Marietta), Mr. Augustine bought gaskets for the Titan launch vehicle yearly from a supplier who primarily supported the automotive industry. Mr. Augustine imposed all of the "government's inspection and paperwork requirements as stipulated by the government's procurement regulations."[7] One day a box arrived filled with gaskets and a note attached from the supplier's president indicating the company wanted to support national

defense efforts, but they could no longer do business with Martin Marietta. "It ended by saying, 'Here is a five year free supply of gaskets. Now, would you please go away and leave us alone?"[8]

In the summer of 1995, the Deputy Under Secretary of Defense (Logistics) (DUSD (L)) launched an initiative to help educate and expose the military acquisition corps to the fundamentals of an integrated information environment. Thrust Teams were created comprising of the Services, DoD, and other agency members. The eight teams are primarily logistics focused and thus do not appear to have either the authority or necessary influence over the DoD acquisition communities.

- Business Process Improvement
- Digital Product Data
- Education and Training
- Government/Industry Interface
- Integration
- International
- Standards and Specifications
- Technical Data Management

The DoD does offer specific training through the Defense Acquisition University (DAU) for the implementation of integrated information environments in varying degrees, but no comprehensive course for PMs. Again, the training courses are functionally based.

Evolution of APDEs

Several organizations included in the research are developing APDEs, although full implementation depends on how they channel efforts in a few key areas such as:

- Standards and a common data environment;
- Digital connectivity;
- Information life cycle;
- The Internet;
- Raising interest up the chain;
- Contractor Integrated Technical Information Service (CITIS);
- Funding;
- Workflow managers; and
- Training.

Standards and a Common Data Environment

Lately, there has been a great deal of movement from more rigid military standards to commercial standards because of the potential for significant savings. The DoD is actively pursuing the use of commercial standards such as ANSI X12, standard generalized markup language (SGML), initial graphics exchange specification (IGES), and Standard for The Exchange of Product model data (STEP). The same appears to apply in the preference of commercial off-the-shelf (COTS) over government off-the-shelf (GOTS) packages. Quite a few organizations interviewed institute commercial products as a solution for the management, exchange, manipulation, and storage of electronic data, because few DoD sponsored standard systems like joint computer-aided acquisition and logistics support (JCALS), joint en-

gineer data management information control systems (JEDMICS), and configuration management information systems (CMIS) are still under development, not yet mature, and considered by some to be less capable than commercial alternatives. Some organizations also want to avoid the *Ada paradox*, according to a senior DoD official, where what had been originally designed to be a solution to interoperability has become a burden for everyone.

In the field, program partners are making agreements regarding what formats should be used for sharing databases and what works today. Even though the focus appears to be on short-term data reusability, there is a growing interest to consider the long-term data requirement. However, the imposition of standards like SGML and STEP are often misunderstood, too costly, or unnecessary—an expensive proposition to push during the design process without a demonstrated need. Another difficult choice organizations have to make is the selection of a common operating environment that is interoperable with their business partners. One organization requires people to use up to six separate systems a day to access program information because the organization can not select a common system or incorporate adequate interoperability among the different databases being used on a daily basis.[9] Fixing this problem, according to one program manager (PM), is like "mission impossible" trying to deliver against multiple requirements when trying to operate in an Integrated Process and Product Development (IPPD) environment (see Figure 4-2).[10]

More and more, senior DoD staff personnel stress getting away from military standards. Military standards are not kept current with todays' technology and prevent PMOs from working faster, better, and cheaper.[11] Not surprisingly, organizations like the U.S. Navy's

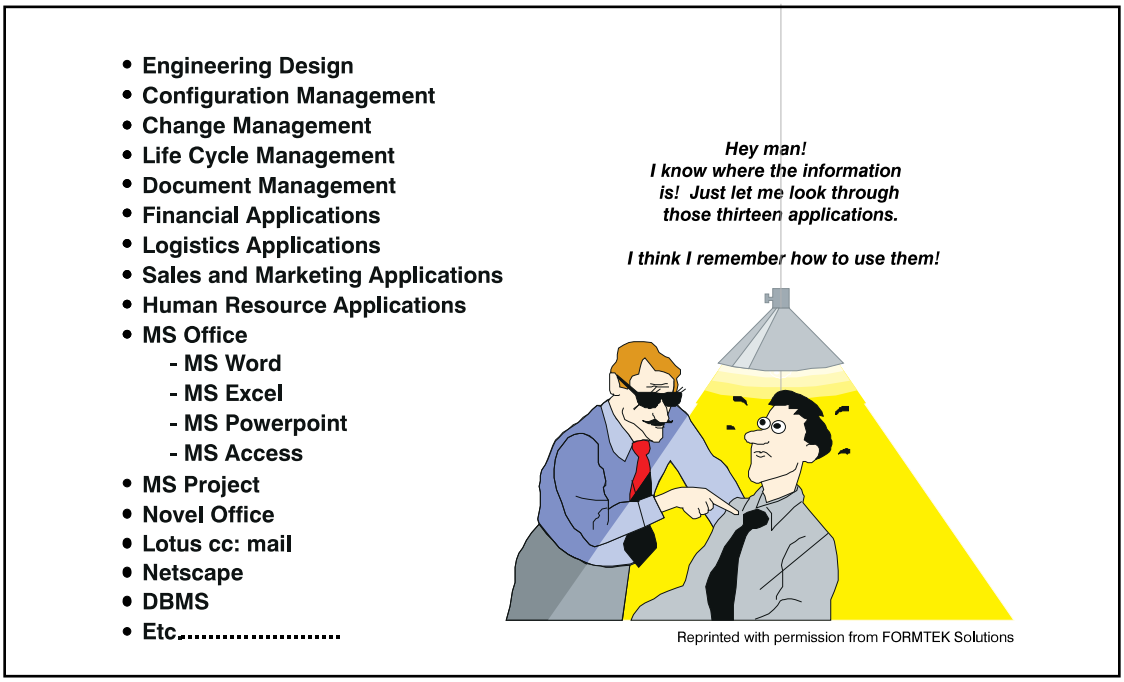


Figure 4-2. Data Access Today

PM-299 PMA, Airborne Low Frequency Sonar program, capitalizes on a common system utilizing a COTS solution. The COTS solution helps PM-299 PMA establish a common integrated information environment similar to an APDE. Avoiding proprietary specialization, they now have access to data, a full workflow manager, and work scheduler. Instead of conceiving their system as a functionally distinctive logistics product, they look at it from an overall IPPD structure to include acquisition *and* logistics. The PMO uses a mature product information management system that manages, controls, and automates the process employed to create, review, release, and manage program information during the acquisition phase. While the weapon system is in operations, the same integrated information system will be utilized.

Likewise, the Air Force's F-22 PMO recognizes that while most of their development and support data are in digital form, there is no integration across functional boundaries. As a result, the PMO is developing application interfaces within their integrated weapon system database (IWSDB) that will link disparate domains across the acquisition and operational spectrum. Figure 4-3 shows such integration across functional entities. The results will permit the developer, maintainer, and user to ask questions at any level of complexity, retrieve the appropriate data, and take corrective action, as appropriate.

Organizations with established common information environments understand the payoff. Boeing's Commercial Airplane Group talks frequently about the significant savings they achieved during the development of the 777 aircraft series. Boeing exceeded their goal of lowering engineering change requests and achieved a 93 percent reduction over the 767 program by instituting a common computer-aided design/computer-aided manufacturing (CAD/CAM) system among their supplier base. Likewise, the U.S. Army's Patriot Missile Program is getting their message out on the World-Wide Web (WWW). Through a *paperless* engineering change proposal (ECP) environment, they electronically dispositioned over 130 ECPs without holding a single "face-to-face" Configuration Control Board (CCB) meeting in over a year. The PATRIOT program reports a first-year savings of $250K, through the elimination of paper, reduction in travel, and the migration into a common system information environment.[12]

Another advocate of common digital environments is the Joint Strike Fighter (JSF) Program Office, formerly Joint Advanced Strike Technology (JAST) Program Office, located in Crystal City, Virginia. They operate in a paperless environment, unless by exception. Early on, the JSF program office pushed electronic procurement hard, even though there were few standards or experienced personnel to guide such efforts. They train, make decisions, plan upcoming phases, receive and evaluate deliverables, award contracts, conduct frequent management reviews, and review technical information—all electronically in a common data environment. In addition, they have on-line access to contractor's management information systems (MIS). The JSF program also uses an Internet Web site to: distribute solicitations, broad agency announcements, and Request for Proposals (RFPs); respond to questions from potential offerors; inform prospective bidders of the latest information that might affect contract proposals; and answer questions related to their solicitations. The JSF program has declared business with them will take place digitally and subscribes to a common information systems environment.

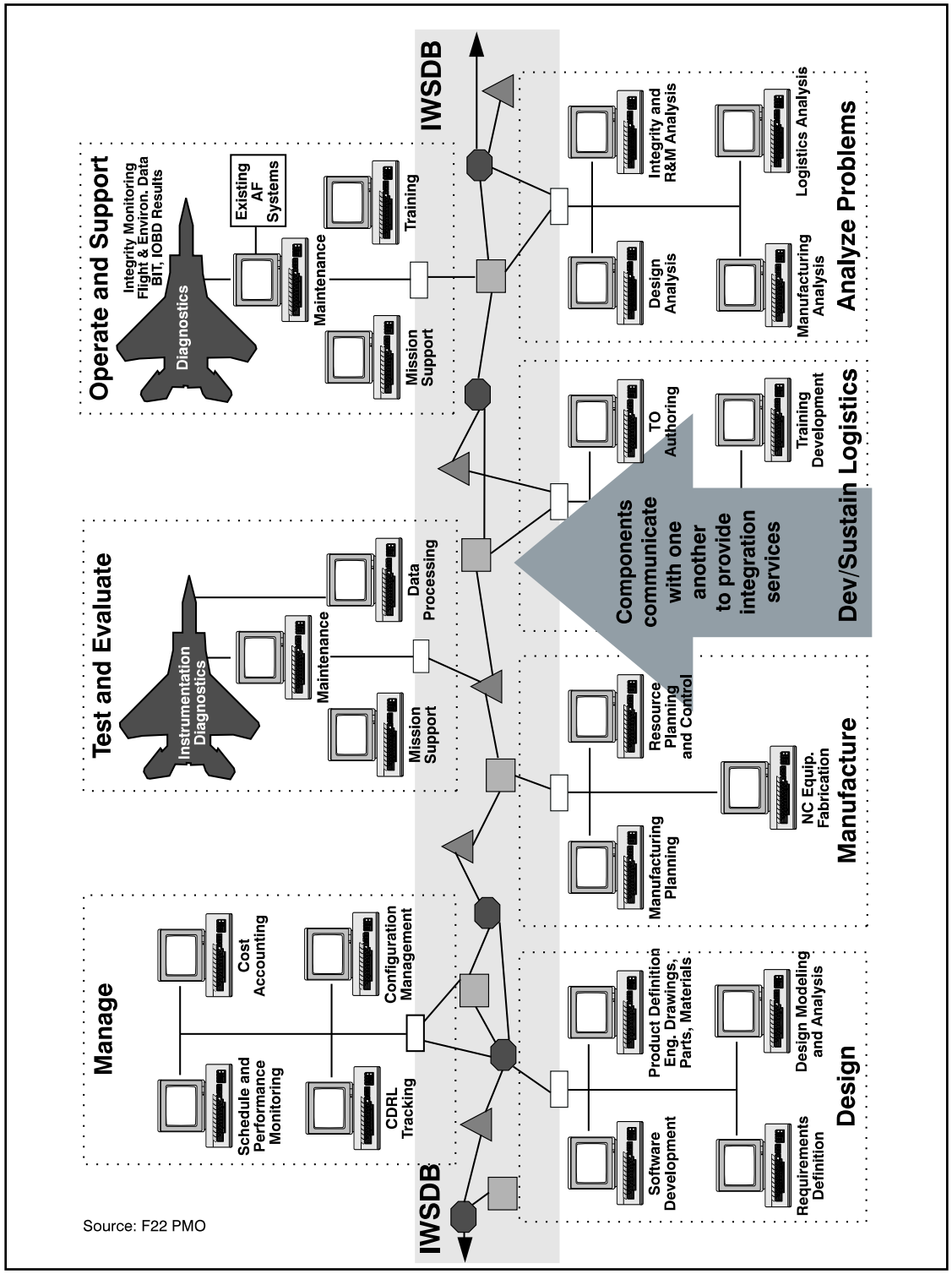


Figure 4-3. F-22 Integrated Weapon System Database

Information Life Cycle

A cultural boundary blocking the systematic development of an APDE is the result of the DoD acquisition process encouraging PMs to be milestone driven. Even though they make decisions that will impact the total life cycle costs for their weapon system, PMs rarely stay with the same program once its fielded. There is concern this approach reduces the motivation to view information as a long-term asset, and accommodate design decisions which *may* have projected life cycle savings but incur short-term costs. There is also a belief that such "up front" investments may defer other critical initiatives even though the downstream savings of an APDE covers the initial infrastructure costs. Unfortunately, PMs are evaluated on reaching the next milestone on time within current annual budgets, and have little incentive to reduce long-term life cycle costs. To correct this problem, a few organizations like the LPD-17 project (the U.S. Navy's newest class of amphibious vessels which will functionally replace a number of ships) are establishing an integrated APDE concept early and expect to reap significant long-term savings by "designing for ownership." They view information as an asset and accept that this may incur an initial up-front investment, but expect to reduce traditional life cycle maintenance costs by 40 percent.[13] Figure 4-4 depicts the LPD-17 life cycle vision. Because the LPD-17 project emphasizes rapid, affordable performance upgrades as a fundamental design principal, they recognize what data should be bought digitally, and how it should be integrated and reused.[14]

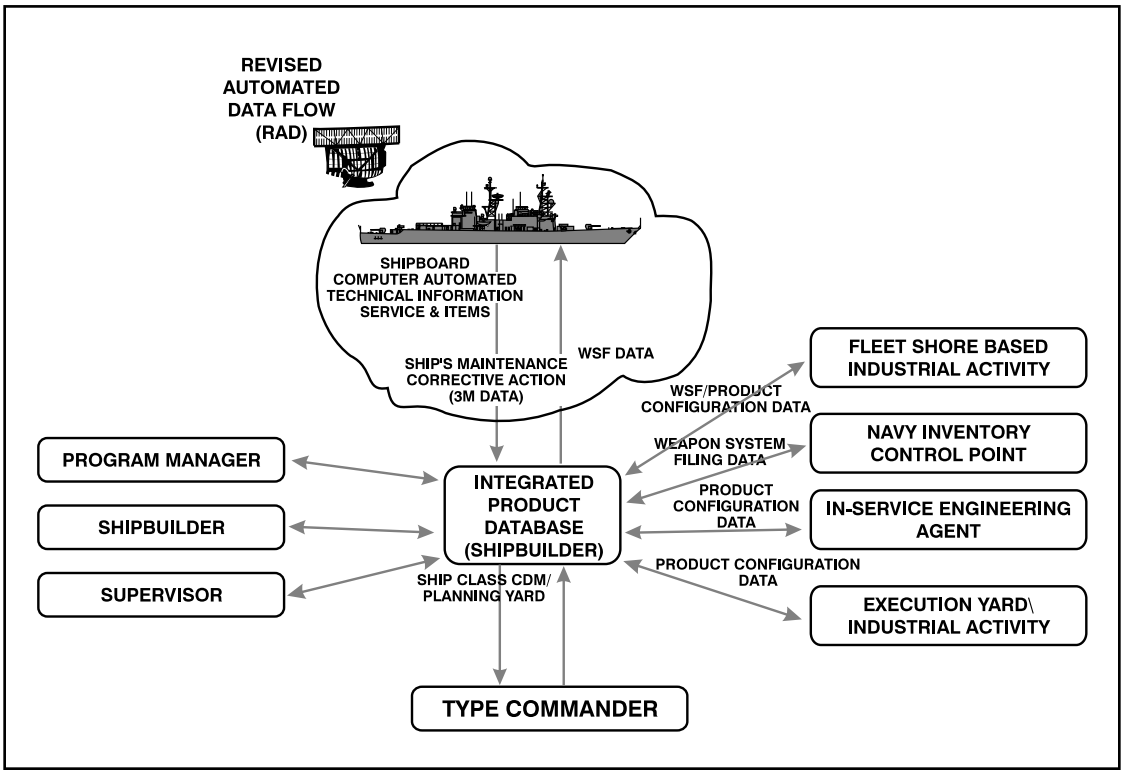


Figure 4-4. LPD-17 Life Cycle Vision

At the same time, however, there are many legacy programs like the U.S. Air Force's C-17, that started the design process on paper well before integrated digital environments were realizable. Recently, they have started evaluating digital opportunities, although much later in their design process. Of the almost 26,000 drawings covering about 126,000 parts in the C-17, less than 15 percent was actually produced in digital form, making movement up the APDE continuum more difficult.[15] As part of an Omnibus Program to digitize and integrate more of their processes, the C-17 PMO is carefully evaluating options to meet future data needs. One option is access to a sustained CITIS environment after the C-17 is fielded.

Raising Interest up the Chain

The impetus for generating most integrated APDEs is often originated by advocates lower in the ranks, and survive only with senior leadership support. At one defense contractor facility, an individual responsible for helping craft an integrated information environment faces a lack of understanding from corporate leaders, coupled with a lack of incentive from the DoD. Another defense contractor has three separate groups developing similar systems for their respective digital environments at the program level, because senior management provided neither oversight nor developed a corporate approach. In many cases, the appropriate people at the helm who are in positions to help are uninformed, feel uneasy about the technology, and are unsure about its application. One senior individual in a DoD PMO is doubtful what an integrated information environment provides. If there is not at least real-time access to the financial reporting system of the prime contractor, there is no point in having the system. Not surprisingly, that same organization's digital infrastructure is weak and divided. There is no master plan and its organizational members can not readily access the required data when they need it. Notwithstanding, as a general rule, increased interest and attention by senior leadership normally pays off even though most of the time it is a *tough sell*. Many organizations, particularly ones competing in commercial markets, are actively integrating the digital activities within their enterprise. They can not afford the consequences of sitting idle and believe their competitors will acquire an advantage, and ultimately gain market share.

One organization's development of operations and formulation of an overall business strategy involves percolating questions to senior executives to properly tackle data requirements and construct a suitable APDE.

- Should we standardize?
- Should we have a single face to our suppliers and customers?
- Would standard interface definitions and implementation conventions for exchanging data with customers reduce support costs?
- Are there requirements for an application architecture to bridge source systems and trading partners?
- Should we deploy a CITIS to our customers and suppliers?
- What are the common requirements across business to manage, access, and distribute technical data?

Many organizations have different motivations to adopt digital environments. One organization believes downsizing is the incentive to go digital. Other organizations focus on process

oriented motivations and look at the cost of ownership early; becoming convinced that understanding long-term data needs and information interoperability would reap major savings in life cycle costs. A few organizations who successfully advance along the APDE continuum simply do so because personnel resources are diminishing, evidence shows it is a profitable proposition, it opens avenues to new markets, or provides customer service enhancements.

Funding an APDE

In the absence of direction, organizations weigh the requirement for integrating their digital environments principally for two major reasons—competitiveness and profitability. Organizations tend to support the development or mandating of common databases, standard transaction sets, and/or integrated workflow activities between themselves, their trading partners, and/or supply chain—if the return on investment (ROI) is apparent. A cost-benefit analysis has to be shown. If the need is not apparent to senior leadership little attention is given to funding an APDE. However, senior leadership is easily persuaded to adopt an APDE approach when cost savings are shown to be dramatic. One organization estimates that processing a paper purchase order cost $70, as compared to 93 cents processing the same purchase order electronically.[16] For some organizations, the results of the cost-benefits analysis highlight the advantages of purchasing computer equipment for their suppliers, thus creating a shared data environment. In another case, an organization provides a preferred pricing arrangement on a particular CAD/CAM software application to their supplier, establishing a shared common system design environment, helping them overcome costly standardization issues.

Despite the perceived savings, sometimes moving to an integrated information environment is inhibited by the organizations' size and entrenched infrastructure. According to one organizations' in-house observer, they are slow to incorporate an integrated information environment because it takes "a while to get our rudder in the water and get the ship turned around."[17] This was also true within DoD. Acquiring funds, and sometimes protecting the funds, for an APDE is difficult given a limited budget for infrastructure and misunderstanding of the long-term payoffs. The U.S. Army's Combat Mobility Systems (CMS) program sought assistance and secured additional funding to help finance an APDE. After screening the PMs' information requirements and deploying an APDE, the PMO quickly discovered a number of significant tangible benefits:

- Improved business processes for increased efficiency;
- Assisted in efficient resource allocation;
- Reduced redundancy in work load;
- Reduced administrative burden;
- Reduced manpower associated with status reporting;
- Placed information in a common environment to allow data sharing;
- Enabled personnel to quickly locate information on demand;
- Expedited exchange of information, facilitating better communication;
- Provided infrastructure for immediate access and delivery of program information;

- Provided means for data review and comment on-line; and

- Provided capability to investigate and obtain timely information on demand.[18]

Another PMO needed to demonstrate to the Systems Commander an ROI before making any further purchases in digital technology. Later, they were given the green light to deploy a system for $2M and quickly realized $2.7M in savings in the first few months.[19]

Training

With little exception, the research found most organizations do not possess the corporate knowledge or a training program to support creating, feeding, and nurturing an integrated APDE. Successful organizations interviewed seek outside consultation or develop a core group of organic expertise, but the majority are not actively exposing their personnel to the benefits of an APDE-like system. One organization admits to making it up as they go along, because those responsible for implementing a new system are in the process of learning themselves.[20] As one project manager states, "the training PMs and other personnel receive on digital technology and/or processes is either on the job or whatever they can obtain on their own."[21] Most site visit interviewees appreciate what APDEs offer and feel training needs to be a top priority; at the corporate level there is no evidence this is taking place or emphasized. In some cases, even when formal training is offered, it is generally given low priority and not well attended when scheduled.

In both DoD and industry, the predominant digital-related training courses apply to electronic data interchange (EDI), ANSI X12, continuous acquisition and life cycle support (CALS), basic software applications (E-mail, word processing, database applications, spreadsheet, etc.). EDI training predominantly limits itself to contracting and purchasing; while CALS training courses concentrate on logistics and sustainment of mature product data for the logistics community. In one organization, general tutorials, self-help opportunities, and library materials on digital initiatives are available yet seldomly used. Overall, training appears to be functionally based. There is no focus on integrating functions and processes.

Digital Connectivity

Most organizations surveyed have an e-mail system internal to their organization. Primarily, the e-mail provides a means of basic communication and file sharing. In some organizations e-mail can be used as a fundamental enabler for greater digital connectivity, streamlined communication, and decreased response time; all which ultimately result in increased productivity. Most e-mail systems also have Internet access. However, in many cases individuals do not use external e-mail, which is directly attributed to lack of training or an uneasiness about using digital environments as opposed to using paper environments. Organizations that routinely transmit e-mails outside the organization tend to better appreciate the possibilities for cross functional, integrated digital environments.

The development of an APDE requires an understanding of digital technology and the cross functional nature of information. Many organizations rely on their MIS personnel to set an APDE into motion and expect them to select the necessary infrastructure. Unfortunately, the MIS personnel are usually consumed by daily hardware and software operations. They tend to system crashes, update software and hardware, plan for future upgrades, schedule computer training, or explain why the computer

network is down. In many cases, MIS personnel do not have an understanding of data requirements, and consequently are unable to develop an APDE to support those requirements.

Internet

Probably one the most interesting areas where organizations are beginning to explore other prospects of digital interconnectivity is the Internet. The earlier Local Areas Networks (LANS) that evolved into wide area networks (WANS) have now become the widest global area network—the Internet.[22] Many organizations have browsers, such as Netscape, on desk top computers giving personnel access to the World Wide Web (WWW) to probe relevant sites and potentially expand business opportunities. Some commercial organizations offer virtual storefronts on the WWW to reach new markets; while others use it to speed communications. The Bank of America uses the Internet for making payments with an astonishing round-trip transit time under ten minutes, including processing times at both ends.[23] One organization establishes a set of metrics giving them an indication how marketing on the WWW brings in additional business. Organizations who extended their reach even further along the APDE continuum appear to be supporting the exploration of even other Internet prospects. An advocate in one commercial organization believes the Internet possesses the inherent functionality to integrate more of the organization's internal and external digital processes. Senior leadership supported a "proof of concept" demonstration for the on-line exchange of digital data between their organization and its supplier base solely via the Internet. The demonstration, conducted from an employees home gained access to the organization's corporate network, and transferred data across the Internet to the supplier base. While this demonstration did not employ exotic encryption methods, partition data to authorized users, or incorporate workflow functionality, it did illustrate the benefits of simplified real-time access to data between the organization and its suppliers. It also shows the reliability and simplicity of the Internet. The demonstration involved password protection techniques, Web browsers, form submission tools, and e-mail via hyperText markup language (HTML). In terms of savings, transferring manufacturing data via the Internet during the demonstration had an expected reduction in physical media costs of 78 percent and a reduction in turn-around time of 92 percent.[24]

The Non-Line of Sight (NLOS) PMO, which is developing the Enhanced Fiber Optic Guided Missile (EFOGM) for the U.S. Army, constructed a similar Internet model, placed it into practice, and are quite pleased with the results. All documentation for the weapon system development generated by the contractor team such as trade studies, requirements and design specifications, briefings, cost documentation, analysis results, plans, reports, etc. are created in an integrated electronic environment and delivered to the NLOS PMO via the Internet. Minimal hardware and software expenditures account for increased program savings.[25]

The Internet does present a few security concerns driving many organizations to use point-to-point digital connections as either a primary or back-up device. However, many organizations believe the Internet's attributes will make it the vehicle of choice for a number of reasons:

- Ease of use;
- Multimedia capability;
- Relatively low cost of access; and

- Wide range of Web compatible COTS options.[26]

Another major defense contractor believes the Internet is extremely attractive to disadvantaged business suppliers who cannot normally afford multiple non-standardized digital solutions.

CITIS

The careful design of a CITIS is probably the most important decision a PM can make in satisfying program data needs through an APDE. This is especially true in light of the new requirements of DoD 5000.2-R which states: "Support concepts of new and modified systems shall maximize the use of contractor provided, long-term, total life cycle logistics support."[27] In most cases, a contractor's CITIS is robust enough to provide easy access to the data. This research revealed many variations in how DoD organizations establish and maintain connectivity amongst information environments. MIL-STD-974 defines the functional requirements for CITIS, and has permitted a great deal of flexibility as evidenced by its four implementation strategies.

- Database repository resides with the prime contractor as a single physical integrated database.

- Database repository resides with the prime contractor as distributed multiple databases with a navigator (gateway processor).

- Database repository resides with the prime contractor; existing information systems are interfaced to extract CITIS data in a central repository.

- Database repository resides with the prime contractor and suppliers (many), with a navigator to pass requests/access to supplier databases.[28]

Some PMOs tap directly into a prime contractor's CITIS, located either inside or outside the contractor's firewall and extract the appropriate data on demand. (See Figure 4-5.) Other PMOs avoid a CITIS and have the contractor deliver digital data to a remote server which is operated and maintained by the sponsor.

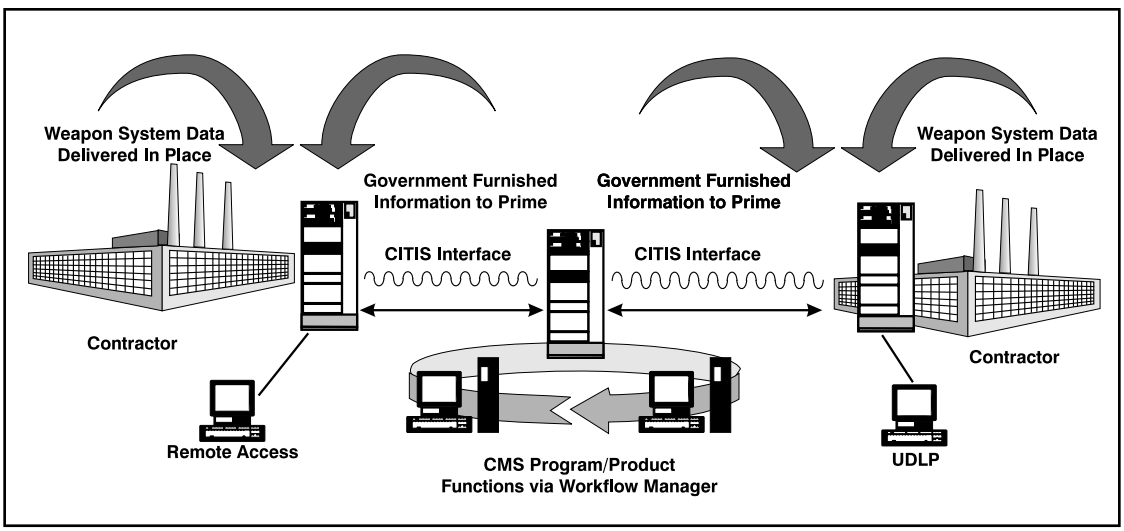


Figure 4-5. CMS CITIS Arrangement

Producing an efficient CITIS and justifying its usefulness is not an easy undertaking. A CITIS should have certain characteristics that everyone on the team understands and be simple to use. CITISs must be reliable and straightforward; otherwise, the exchange of digital information whether technical data, drawings, schedules, or general reports can become a cumbersome and inefficient operation.

In one case, the implementation of a CITIS turned into a disaster. A PMO contracted for a CITIS and expected a far more integrated and automated environment—a point-and-click approach. The delivery was an "awkward X-windows character-based monstrosity" which the PMO essentially refused to use.[29] To overcome this situation the PMO's expert MIS, joined by a support contractor, built a Web server to access CITISs manually. Each document was placed on the Web server for access by the integrated product teams (IPTs), with a point-and-click capability. Although tedious to develop, operations ran smoothly forcing the contractor to abandon the original CITIS approach and begin utilizing the government's Web server for obtaining copies of their own documents.[30] Eventually the contractor replicated the PMO's design on their own system, thus recognizing the advantage for them to be the sole curator of the document repository.

Another organization discovered that to even sell a CITIS environment to the PMO and senior management, they had to demonstrate the service. An actual CITIS simulation generates a high degree of interest, excitement, and buy-in at all levels, as opposed to the previous marketing method of slide shows and paper documents.

Some organizations, however, do not feel comfortable with CITISs. They are concerned about the proprietary nature and data security. In one case, it is believed the risk of direct access leads the contractor to charge more than the government is willing to pay for a CITIS. Interestingly enough, the same commercial organization's sister site has already given the government unlimited access to another CITIS environment.

In two cases, the PMO has decided to forego a true CITIS implementation. The PMOs decided to maintain their own servers and have their contractors populate these servers with contract data requirements list (CDRL) data that are ordinarily available via CITIS. In one case, there is concern over contractor access to government data. In the other, the contractor's CITIS implementation is not compatible with government software applications.

How a PMO views the life expectancy of a CITIS after selecting one of the four CITIS implementation strategies is often a result of how satisfied the organization is with the CITIS environment in general. In some cases, the government decides to have the contractor develop and maintain a CITIS, exclusively, throughout the life of the weapon system; as in the case of the Air Force's B-2 program. After conducting a feasibility study, the B-2 PMO decided to have its principal contractor, Northrop Grumman, house and maintain a certain set of digital data required for field operations and maintenance which the government originally purchased. It is envisioned that the field unit will tap into Northrop Grumman's CITIS on demand and retrieve the appropriate technical manuals, engineering drawings, etc. Information location is transparent to the user. The key is information is available where they need it, when they need it, and in a cost effective and timely manner, satisfying the spirit of DoD regulation 5000.2-R.

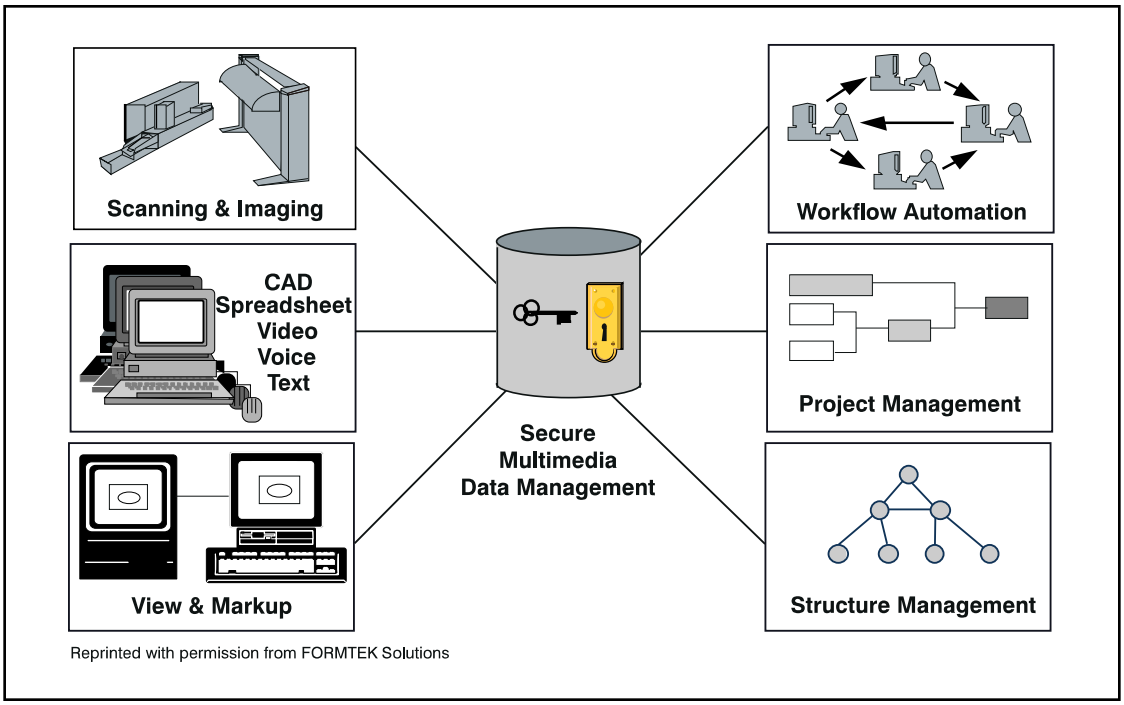
The Air Force's B-2 program is a good example of a legacy program that migrated to a CITIS

environment and was able to move further down the APDE continuum much later in their program's acquisition life cycle. They originally admitted having islands of databases which were costly to maintain and disjointed. They launched an effort to integrate their information environments late by showing the savings in total life cycle costs. After the CITIS Phase II is complete they will have digitally linked 66 data elements comprised of engineering drawings (3-D and 2-D), desktop publishing documents, and routine documents in an integrated digital fashion. While the implementation cost of $27.2 million is high, the expected savings over the long-term is significantly higher.[31]

Workflow Managers

Workflow managers, described in Chapter 2, are key enablers for integrating and automating processes, and supporting IPTs and IPPDs. A few organizations are incorporating a wide variety of tools like workflow managers into their integrated digital environments. Figure 4-6 depicts one organization's vision of how a workflow manager fits into APDE-like infrastructures.

In many cases, however, organizations establish cross-functional work group membership on e-mail systems and use it in a quasi-workflow manager fashion. Unfortunately, problems occur. Team membership keeps changing, forcing continual modification of personal e-mail group directories to reflect current membership. In a few other cases, the team members hunt for the information they are expecting to review, thinking they have access authority, or have access authority, but can not easily access the information they need. Products like e-mail, project management, and



Reprinted with permission from FORMTEK Solutions

Figure 4-6. FORMTEK Solutions

scheduling are low cost productivity tools but "do not allow for coordinating or tracking processes with multiple steps and/or multiple users."[32]

Most of these problems can be overcome by genuine workflow managers. Because of its recent emergence, the concept of workflow managers are relatively unknown by most organizations. However, those organizations who employ workflow managers are excited about its applicability, pleased with its ease of use, and have already seen a marked improvement in data flow between the cross-functional teams. Some commercial organizations see workflow managers as a distinct competitive advantage. One commercial organization shortened the business processing time from 14 days to 4 days and feels delivering faster than the competition is one of the few edges left in a very competitive marketplace.[33] A defense contractor noticed how quickly they could check for work completion, uncover design problems, incorporate the necessary modifications, and notify the appropriate personnel of changes, thereby greatly reducing the entire approval cycle and improving the organi-zation's overall performance.

Summary

While there are many innovative digital initiatives ongoing throughout DoD, for the most part, the acquisition community is not fully prepared to capitalize on the benefits or potential of integrated digital environments. Implementation of digital environments widely differs between the Services and PMOs. Lessons learned by industry in the exploitation of the information age and information technology are not well understood or appreciated within PMOs. The driving forces for organizations to adopt APDEs are reducing overall costs and increasing performance; not policy, mandates, or DoD direction. The evolution of an APDE typically starts with common data environments and standardized business practices at a local or process level, and with short-term objectives. Few PMOs appreciate the ramifications of an inoperable data environment at the program level—islands of databases which are functionally based, duplicative, disjointed, and force lengthy serial processes. Fewer still develop an overall long-term digital master plan supporting data reuse and treating information as a life cycle asset. Some organizations discover an important element toward integrating digital environments is a CITIS, a first step toward overcoming disparate government and contractor databases. Some are more innovative and explore emerging technology such as CAD/CAM, Internet, and workflow managers. Those who recognize how an APDE will improve efficiency and integrate processes are often junior in rank, seeing themselves as change agents despite a tough sell with senior management. Regardless, many organizations involved in adopting commercial products, standards or conventions for the creation, manipulation, and exchange of data are realizing immediate gains. Even where short-term gains are not evident, the overall long- term benefits in terms of productivity and supportability are recognized and deemed worth the up-front costs.

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26. Interview with defense contractor, Apr 96.

27. Office of the Secretary of Defense. (March 15, 1996). Department of Defense Regulation 5000.2-R, mandatory procedures for major defense acquisition programs (MDAPs) and major automated information system (MAIS) acquisition programs, paragraph 3.3.7. Washington, D.C.: Author.

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31. Defense Daily, 191, 304. (May 21, 1996).

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5

NEGOTIATING THE DIGITAL ENVIRONMENT

This chapter provides a structured approach to the development of an Acquisition Program's Digital Environment (APDE). It highlights key areas of concern and helps to identify many of the questions and issues that Program Managers (PMs) need to address. In addition, it highlights basic information required by program management offices (PMOs), where to go for help, and provides a methodology for developing a Concept of Operations (CONOPS).

The APDE

As described in Chapter 3, there are considerable potential benefits offered by an integrated information environment, or APDE.

> *The time for revolutionary change in our information practices is now. By leveraging available technology and modifying business practices to better capture the efficiencies available through the use of shared information, significant cost savings can be realized throughout the product life-cycle.*[1]

The goal of an APDE is in fact more than direct cost savings. More important are: the savings achieved as an outgrowth, or by-product, of an APDE; and the potential to decrease cycle times, increase efficiency, improve data flow and system supportability, while dramatically improving the quality and timeliness of decision making processes at all levels.

An APDE is a necessary precondition to achieving major process improvements or reengineering. But to what extent does it make sense for a given PMO to develop an integrated digital environment? The development of an APDE can be a significant undertaking and very costly in terms of time, personnel, equipment, and monetary resources. It can range in complexity from the very simple to the very complex. At the low end, key people may share e-mail and limited information sets within the PMO and/or with the prime contractor, perhaps incorporating Netscape to facilitate data access. At the high end an extensive digital infrastructure enables every active participant to have direct access to all pertinent data relating to their particular function or process, regardless of the physical location of the database. (Refer to Figure 2-8 page 2-14 for the researchers proposed APDE model.) These active participants include not only the PMO and prime contrac-

tor personnel, but also sub-contractors, vendors, suppliers, support agencies, and end users. What is right for a particular PMO is a point somewhere along this continuum. If too little is done, the Department of Defense (DoD) does not fully realize the potential benefits of the APDE. Do too much and the return on investment (ROI) is diminished, or costs may even increase. How far to go depends upon a variety of factors including:

- Type of acquisition system being developed;
- Present phase of development;
- Contractor capabilities;
- Existing processes;
- Current automation infrastructure;
- Need for information sharing;
- Physical location of various key personnel and organizations; and
- Available resources (this is foremost).

What Does the PM or PMO Need to Know

The PM must have the vision, or ability, to understand the potential for a cross functional integrated digital environment. Interviews have shown that extensive technical knowledge or detailed functional acquisition experience is clearly not a prerequisite for the success of an APDE. In fact, too much technical background or experience may result in decisions being clouded by pre-conceived ideas. The PM must understand that information itself is an asset that needs to be managed carefully over the entire life cycle of the program. Information is more than simply a gathering of data used to describe assets and actions. Information has value, it has multiple uses and purposes, and it supports everything relating to the acquisition program. Properly managed, information can save time, increase efficiency, improve system quality and performance, and reduce cost. The APDE enables this effective management of information and information processes.

Gain Access to the Right Tools

In most PMOs interviewed, there existed a general lack of experience and knowledge with respect to the potential, requirements, capabilities, and limitations of an integrated digital environment. DoD acquisition personnel, and many industry managers for that matter, do not feel adequately prepared to develop an APDE infrastructure. The general sentiment from several interviewees was that "we don't even know enough to ask the right questions, let alone come up with the answers." It is important for the PMO to be able to access information and personnel that can help them negotiate an APDE development effort. The PM needs individuals with an understanding of APDE related areas such as: available technology; network support and network security; communications requirements and capabilities; data rights and access restrictions; contractor integrated technical information service (CITIS); computer-aided design/computer-aided manufacturing (CAD/CAM); Continuous Acquisition and Life-cycle Support (CALS); electronic commerce/electronic data interchange (EC/EDI); national and international standards; and lessons learned from other PMO initiatives. In many cases the information and assets are not found within the PMO. Training programs, other DoD agencies and PMOs, consultants, outside research, and contractors should be used extensively to support the APDE development process.

The PM Must Be Involved: APDE ≠ Logistics

The DoD strategy for an integrated data environment (IDE) is being developed by the DoD CALS office. Although CALS officially encompasses the entire "lust-to-dust" life cycle of a program, the effort is run by the logistics community and has historically had a logistics focus.[2] As a result, there is a tendency by materiel acquisition and program management to relegate IDE and CALS issues to their senior logistics personnel. This is a mistake. The PM must understand that the APDE, an acquisition program's functional equivalent to the IDE, potentially interconnects all program processes to become an indispensable tool for the PM. The APDE impacts all stakeholders to include:

- Entire PMO;
- Industry partners: contractors, manufacturers, integrators, and vendors;
- Coordinating agencies such as contracting and finance;
- Support agencies such as maintenance and sustainment activities; and
- Ultimate end users.

Not only are stakeholders impacted, but an APDE also impacts areas critical to a program's success:

- Acquisition management;
- Financial management;
- Procurement planning and contract management;
- Engineering management;
- Logistics management;
- Test and evaluation; and
- Production management.[3]

While much credit appropriately goes to the logistics community that is attempting to develop an environment that supports this integration effort, making it happen is an acquisition PM's responsibility. The logistics community or the senior logistician within a PMO does not have the training, the experience, the responsibility, or the program authority to bring all these various functions, activities, and processes together. That is the job of the PM, the PMO staff, and their industry partners.

Contractor Involvement

The cooperation of, and coordination with, the prime contractor is perhaps the most important ingredient to a successful APDE implementation. While this may seem obvious, there is often a "we-they" relationship between PMOs and contractors that detracts from the effective development of an integrated digital environment. The PM must try to overcome this potential barrier and work toward a true partnership with industry. While the government's goal is a quality product for a fair price, the contractor's goals include a fair profit for the work they perform. Perhaps the real solution is attainment of both sets of goals.

An APDE offers a unique opportunity for a total win-win situation, providing significant cost savings and other programmatic benefits to both government and industry participants. The new DoD Regulation 5000.2-R, dated March 15, 1996, cites that "award programs (both monetary and non-monetary) and 'shared savings' programs shall be used creatively to encourage the generation of cost-saving ideas for

all phases of life cycle costs."[4] The PMO and associated contractors must jointly identify and develop a strategy that (a) supports the objectives of a truly integrated digital environment, and (b) works to the mutual benefit of all concerned. Ideally, the APDE is a digital partnership between government and industry which is cross functional in nature and extends beyond a CITIS environment to support the full life cycle of a program.

Getting to this point may not make good business sense in some programs, but that decision should not be made until a complete analysis of the situation, costs, and benefits have been made by both the PMO and its industry partners. Understanding all parties' goals, objectives, incentives, and concerns of the others is important. In some cases simply involving contractors in the process and enabling them to introduce ideas that are of mutual benefit is sufficient to promote action. As PM Combat Mobility Systems (CMS) cited:

> *The PM, CMS IDE effort has had the positive effect of incentivizing their prime contractors, [names omitted], to accelerate internal initiatives to improve operational efficiency. The requirement to eliminate paper deliverables has allowed each contractor to bring automated solutions to the table, thus enhancing the overall IDE effort. While under no obligation to do so, each prime contractor has taken an active role in the establishment of IDE capabilities within their own corporations and improving those with the TACOM [Tank and Automotive Command] community.*[5]

Simply the government's willingness to reconsider outdated ways of doing business and move toward an APDE approach may well be sufficient to spur suggestions, ideas, and actions on the part of the contractor, and from within the PMO.

Today, all major contractors are producing documents, program data, and technical drawings in digital form, while exploring digital environments to some extent. Many organizations interviewed state emphatically that integrating processes internally through a digital infrastructure makes sound business sense and is an essential core competency needed to remain highly competitive. Extending that environment down to suppliers, support chains, and customers (i.e., the PMO), enhances their ability to do business faster, smarter, cheaper. In some cases, contractors even provide both the hardware and software infrastructure to their sub-contractor chain, because even with the added overhead expense it enables them to reduce overall costs and increase efficiency.[6] The point to be made here is the PM should not presuppose that, in order to benefit from an APDE, the PMO must necessarily bear the full cost. The mutual advantages may be sufficient to incentivize industry to share the burden in both the design and implementation. In order for this to occur, they must be true partners—both actively involved in the process.

Where to Go for Information

This section identifies some of the primary sources of information the PM can use to answer the many questions that invariably arise. The PM has significant latitude in determining the method(s) and degree of APDE implementation, and requires an extensive amount of information in order to make an informed decision. Unfortunately, personal interviews and research find there is no single office or organization capable of providing comprehensive information on APDE implementation, as it pertains to the PM's potential requirements. As technology is constantly evolving and there

is no "one size fits all" solution to an APDE, it is incumbent upon the PMO to seek out various alternatives and resources in order to identify the solution that best meets a program's needs.

Surf the Net

Perhaps one of the most useful resources available to any manager today is the Internet. In this project, the Internet allowed us to quickly locate, identify, and communicate with numerous individuals and organizations involved in efforts relating to the subject material. The proliferation of home pages and available on-line reference material, particularly within DoD, provides almost immediate access to updated information on agencies, programs, projects, and actions throughout the world. It supports not only finding previously unknown sources of information, but also permits the user to quickly filter out those organizations and efforts that are of little relevance. While not a panacea, the Internet is a truly viable and useful resource. For the PMO involved in exploiting the digital environment, reviewing information available on the World Wide Web (WWW or the Web) is a must. Possible search criteria might include:

- Acquisition Reform;
- CALS;
- EC/EDI;
- Defense Information Systems Agency (DISA);
- National Institute of Standards and Technology (NIST);
- Electronic Commerce Resource Center (ECRC);
- Lead AMC Integration Support Office (LAISO);
- Joint Computer-aided Acquisition and Logistics Support (JCALS);
- Joint Engineering Data Management and Information Control System (JEDMICS); and
- Department of Commerce (DoC).

Government Efforts

There are various organizations within DoD and the federal government that are involved in the exploitation of digital environments. These include the logistics community, the acquisition reform community, the contracting community, DISA, DoC, and others. It would be beneficial to the PMO to at least have a general understanding of what each of these organizations is doing, how it can potentially impact the PMO's APDE, and what value- added they might be able to offer. In some cases ongoing efforts can have a direct impact on the PMO by providing possible funding resources, technical solutions, or lessons learned.

Funding

A significant advantage to seeking out DoD and other government initiatives is the potential for funding or solutions that incur little or no cost to the PM. There are numerous ongoing pilot and/or demonstration programs. One major PMO received in excess of $5 million from different agencies to fund IDE hardware, software, and infrastructure maintenance as a part of a DoD pilot effort. Other organizations have also received either funding or direct support (hardware, software, consulting, etc.) as part of technology demonstration programs.

The dynamic nature of digital information technology lends itself to the need for testing, demonstrating and validating concepts, and innovative solutions. PMOs willing to participate in such programs, which work to the mutual benefit of the PM and the sponsoring agency, can often take advantage of resources made available by the organization involved in the development effort. Programs like the Industrial Modernization Incentive Program (IMIP), Manufacturing Technology (MANTECH), Value Engineering (VE) program, Independent Research And Development (IRAD) program, and other incentive contracts are possible sources of funding.[7] Additionally, non-DoD sources such as DoC, joint government funding, and state government programs might also be areas to explore. Some of the DoC funded programs included under NIST are: "Cooperative R&D Agreements (CRADA–where companies form partnership agreements with the government), Manufacturing Technology Centers (MTC–that facilitate the development and implementation of manufacturing technology for small businesses), and High Performance Computing & Communications (HPCC–focusing on U.S. initiatives for providing key information services through a National Information Infrastructure (NII))."[8] Joint government funding programs, such as those through Advanced Research Projects Agency (ARPA) and the Technology Reinvestment Project (TRP), might also be applicable, but are largely contingent upon cost sharing agreements between government and industry.[9]

Government Standardization Efforts

The PM needs to examine government development initiatives and pilot programs to determine their applicability to specific programs and the degree to which they relate to the proposed APDE implementation. This is important if the data user community will be employing government solutions. Government off-the-shelf (GOTS) development efforts such as JCALS, JEDMICS, and Configuration Management Information System (CMIS) should at least be considered, particularly as they apply to future maintenance and sustainment functions. Evolving Acquisition Reform (EC/EDI) efforts supporting business processes within DoD may also be applicable. When considering such alternatives, interoperability issues across the total life cycle, within a future DoD-wide digital infrastructure, should be well understood and addressed.

Commercial Developments

The digital environment, and the technology supporting APDE implementations, is evolving at a rapid rate. Commercial products and services within the business community provide numerous functional capabilities desired in an APDE. In some cases these are stand alone applications, and in others they are well integrated environments that support cross functional and process integration. The latter includes CAD/CAM systems, workflow managers, integrated cost-scheduling-management packages, data access and security software, and various intra-net applications. Most of the PMOs and contractors visited indicate that both the PM and the contractor need to at least be cognizant of what is ongoing in the commercial world in order to evaluate the potential benefits. They must also continue to follow evolving technology. From a PM's perspective, this may be beyond the expertise of people within the PMO, but such a study/evaluation might well be worth having the prime contractor or a capable support contractor perform.

Talk to Other PMOs

Learn from the experience and efforts of others. Research interviews reveal that, even

where substantial APDE efforts are underway, there is normally little sharing of information between PMOs on issues relating to the approach to a digital environment, problems encountered, technical solutions, or lessons learned. In many cases PMOs largely consider themselves "operating in a vacuum and inventing a system from scratch." Seeking out PMOs with similar operating environments and taking advantage of their experiences, both good and bad, is the PMs responsibility. The Services, DoD CALS, and EC/EDI offices should be consulted to identify possible points of contact. This is particularly appropriate where different PMOs are working with the same prime contractor. In several instances research shows a prime contractor independently developed different APDE and CITIS implementation environments for different DoD customers. The PMOs could have avoided duplication of development effort and support infrastructures, but were either unwilling to do so or were unaware of the ongoing parallel efforts. Even the contractor agreed that they could have been much more efficient and conceivably developed a more comprehensive integrated environment had the PMOs been interested in consolidating requirements. While many issues within a PMO are program specific, the PM should constantly be open to new ways of doing business and guard against the "not invented here" syndrome.

Who Needs to Be Involved

The application of digital technologies to government acquisition should be seen as a way to improve and streamline all processes by providing better methods of creating, managing, and using data; not as a method of simply automating existing business practices.[10] The entire organization, especially principle contractors and functional experts, need to be involved in identifying current APDE requirements and its potential to meet future needs. This is not to say that decisions are made by committee; they are not. Input should be solicited from many, but a select group of individuals need to be identified to spearhead the effort. In the past, a government team has been expected to develop the program requirements for an IDE. However, research discussions find that by far the most productive approaches are those that involve the contractor early in requirements development process, and actively during analysis and implementation. The contractor typically has substantial experience, a better understanding of the technology, and a clear vested interest in the success of the program.

This APDE development group, essentially an integrated product and process development (IPPD) team, should be chosen carefully, not only based upon experience and knowledge of the system, but also on objectivity and innovativeness. They need to understand how the system works and, more importantly, what makes sense when it comes to determining how the future system should work. The goal is to improve processes, not necessarily improve given functions that relate to a process. This is the key to reengineering, or at least achieving substantive process improvement. An APDE development effort, particularly in the early stages, must try to avoid focusing on turf protection, job protection, pet projects, and potentially outdated ways of conducting business. If those leading the effort cannot be totally open to new ideas and change, perhaps they should not be leading the effort.

Define and Question the "As-Is" Infrastructure /Processes

Each PMO must first identify, and be able to articulate, the existing "As-Is" infrastructure before initiating a plan to develop an APDE CONOPS. No one can develop a road map for

where they want to be unless they first understand where they are. The APDE offers significant opportunities for process improvements and, potentially, reengineering. But this is only possible if the organization understands how it currently does business. The PMO, in conjunction with its prime contractor(s), associated support agencies, and other data users, should attempt to identify:

(a) what is being performed;

(b) how is it being performed;

(c) what is the value-added at each step/phase;

(d) what processes are being supported;

(e) what are the data requirements
- what data are required in the process,
- who in the process needs the data,
- what is done with the data,
- what data/information are provided to the end user; and

(f) why is it being performed in this manner.

It has been said that an IDE, or essentially an APDE, "represents a true departure from the tyranny of "As-Is" systems and data structures."[11] While this may sound dramatic, it does have some merit. Current systems developed as a result of a hierarchical paper-based architecture stem from what has been characterized as the industrial age. Such systems dictate a relatively slow serial flow of information between functional areas with limited flexibility. An APDE enables the PM to restructure the organization around processes, as opposed to around organizational and functional requirements that developed by necessity from the rigid structure of a paper-based acquisition environment. Once the "As-Is" infrastructure is identified, the next step is to evaluate what events, data requirements, and functional processes actually provide value-added. Is each and every step necessary? What is the purpose behind each step? Is there a better way?

APDE CONOPS

The IDE infrastructure has been defined and articulated in the past through a document entitled the *Government Concept of Operations (GCO)*, which reflects government information and data requirements. While the approach is generally the same, within this research effort the term APDE CONOPS has been selected. This is to emphasize the findings that the CONOPS must be, in effect, a joint government-contractor initiative and should reflect a strong partnership between the PMO, industry, and all associated data users. Inclusion of industry requirements reflects the teaming effort required for a truly integrated APDE, and reduces unnecessary duplication of effort on the contractor side. Government requirements should extend beyond the PMO. Care is needed to also address the requirements and needs of support agencies, the logistics community, and the system's end user. The examination of data requirements should not mirror the As-Is infrastructure, but provide a road map to a "To-Be" architecture enabled by the APDE.[12]

The APDE CONOPS articulates the "To-Be" vision for the organization or program; identifies the APDE requirements; provides high-level implementation planning guidance; describes the functional architecture; articulates critical success factors; and establishes milestone schedules for project completion.[13] The CONOPS becomes the de facto standard by which APDE implementations and enhancements are measured. Even when completed, the APDE CONOPS remains a living document.

As the APDE implementation progresses, or as changes occur to the acquisition program or its data requirements, the CONOPS guidance must be revisited and changed as necessary. Regular updates to the CONOPS are recommended as the system matures and the concepts and technologies continue to develop.[14] A methodical approach to the development of an APDE CONOPS is provided below. Supplemental information, along with a sample GCO for a new acquisition program, can be found in MIL-HDBK-59B and the *PM's Digital Desktop Guide* produced by the DoD CALS office.[15]

APDE CONOPS Development Process[16]

Figure 5-1[17] depicts a suggested process for developing an APDE CONOPS. Even in the absence of an aggressive APDE effort, this approach provides a mechanism for the PM, the staff, industry partners, and additional stakeholders to evaluate the use of data and information across the life cycle of the program. It helps to identify and highlight the:

- Adequacy (and redundancy) of data requirements;
- Common data/information requirements and uses;
- User requirements (data, hardware, software, additional capabilities);
- Physical infrastructure capabilities and limitations;
- Interoperability and compatibility issues;
- Potential objectives of the APDE (where we would like to be);
- Mechanism for enabling process improvement / reengineering;
- Framework for cost-benefit analysis; and
- Means to articulate a road map for APDE implementation.

Identify What Types of Data Are Required

Data type deliverables are the data requirements specified on the Contract Data Requirements List (CDRL) for the program. Typically they are categorized by program function, but in an integrated environment individual data elements should be viewed as commodities with multiple potential uses. This life cycle view of data, corresponding to the idea of "create once, use many times," ensures not only that the necessary data are available, but that it is accessible in a form acceptable to all functional users. Table 5-1[18] provides a list of sample data types that may be digitally developed, accessed or delivered, indexed, and maintained. This Table is not intended to be all inclusive.

Identify Who Will Use the Data

Data users are normally the functional organizations that will require access to the program data. Within the PMO they include as a minimum: management, engineering/design, supply, training, manufacturing, and maintenance. Contracting offices, civilian contractors, suppliers, vendors, logistics support, DoD coordinating agencies, and system users also require data access.

Identify What the User Will Do With the Data

The PM needs to identify the data use requirements of the various functional users. Data use requirements are the ways in which chosen data types are expected to be processed. The five methods of data processing typical of most defense systems include:

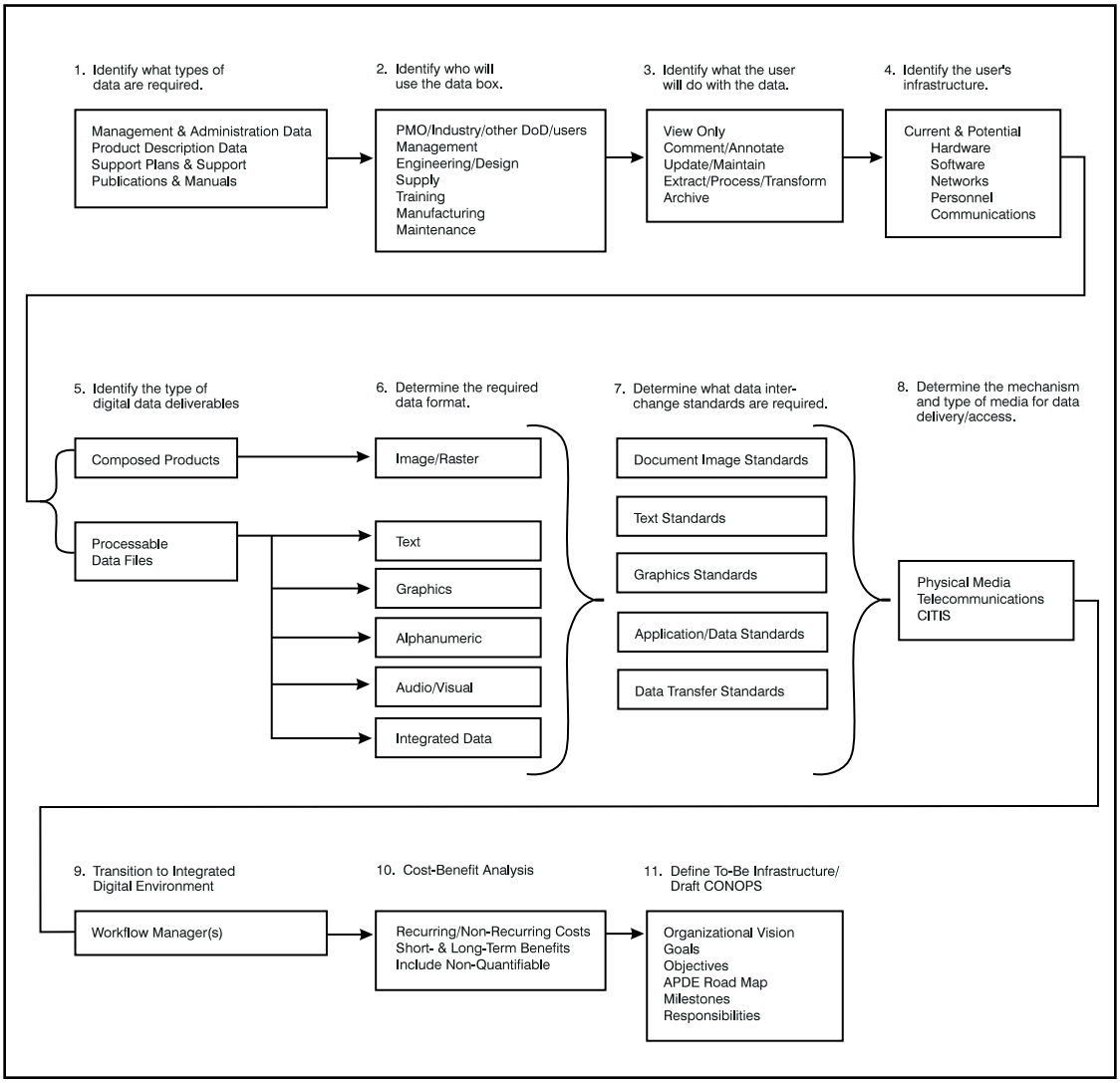

Figure 5-1. APDE CONOPS Development Process

- View Only – examine files without the ability to change it;
- Comment/Annotate – highlight, approve, add notations;
- Update/Maintain – change, add, or modify data;
- Extract/Process/Transform – extract and modify the format, composition, and structure of the data; create standard and custom documents through the extraction and manipulation of data from a variety of sources; and
- Archive – index, store, and preserve data for future use.

MANAGEMENT AND ADMINISTRATION DATA	PRODUCT DESCRIPTION DATA (Continued)
Program Plans	System Engineering Analysis Report
Program Schedules/Master Schedule	Engineering Data
Engineering Support Plans	
Progress and Status Reports	**ILS/LSA PLANS AND REPORTS**
Contractual Vehicles	Integrated Logistics Support Plan (ILSP)
Conference Agendas/Minutes	Logistics Support Analysis Plan (LSAP)
Reviews and Audits Documents	Logistics Support Analysis Record (LSAR)
Technical Data Identification Checklists	Safety Assessment Reports
Standardization Program Plan	Reliability Assessment Reports
Contract Work Breakdown Structure (WBS)	Maintainability Reports
Cost Performance Report	Hazardous Materials/Process Reports
Management Information System (MIS) Plan	LSA Tasks (MIL-STD-1388-1)
Config. Audit Plan/Status Accounting Report	Maintenance Plan/Reliability Plan
Data Accession List	Maintainability Plan
Configuration Management Plan	Level of Repair Analysis (LORA)
System Engineering Management Plan (SEMP)	Test and Evaluation Master Plan
CALS Implementation Plan (CALSIP)	Test Reports
	Life-Cycle Cost Estimates
PRODUCT DESCRIPTION DATA	Manufacturing Plan
Technical Data Package	Environmental Impact Report
System Specifications	Technical Report-Study Services
Engineering Drawings and Associated Lists	Quality Program Plan
Analysis Data	Computer Resources Integrated Support Document
Simulation Data	Design to Cost Plan
Test Data	
ECP, RFW, and RFD	**PUBLICATIONS**
Product Specification	Technical Publications
Software Development Plan	Technical Manuals
Software Test Plan/Description/Report	User's Manuals
System Specification Report	Operations Manuals

Source: MIL HDBK 59B

Table 5-1
Typical Data Type Deliverables

Identify the User's Data Infrastructure

The generation of digital data is of little value if it does not meet the user's requirements. In addition to understanding what data the user needs, and how it will be employed, it is also important to address the user's operating environment. Current and projected capabilities of the entire data user infrastructure, the computing environment available to the user community, must addressed. This includes:

- Hardware;
- Software;
- Networks;
- CITIS;
- Computer support personnel; and
- Communications.

Care is necessary to ensure the compatibility between data, data requirements, and the users' infrastructure. If the APDE is to work, it is important that the users' data requirements, to include how users will actually process and use the data, are supported. Developing a comprehensive infrastructure between the PMO and the prime contractor may achieve limited overall benefit if requirements of key external data users (i.e., support community, sub-contractors, or product end users) are not met. In some cases the best employment of resources to exploit a digital environment may, in fact, be to improve the data infrastructure of data users outside the PMO.

Identify the Type of Digital Data Deliverables

The following are types of digital deliverables supported by an electronic environment:

Composed Products: Human interpretable documents that typically do not support further processing since they are complete, standalone entities. Essentially the digital equivalent to a paper document, they typically contain no embedded digital links or connection to external data or program information (i.e. published reports, scanned drawings/plans, charts and graphs).

Processable Data Files: Machine readable dynamic information that includes accessible source data from multiple data applications. This enables the user to create standard and custom documents through the extraction and manipulation of data from a variety of sources. A simple example is a monthly status report that extracts action, schedule, completion, and cost information from various data sources to construct a single user friendly chart or graphic. The generation of technical manuals (TM) can also receive support through processable data files: figures can be extracted from engineering drawings; system descriptions from configuration management data; maintenance information is linked to current depot support; component re-ordering information is derived from a logistics database; and the TM can be quickly updated with each iteration or revision.

Determine the Required Data Format

Data can be procured in several forms:

- Document image file;
- Text file;
- Graphics file;
- Alphanumeric file;
- Audio/visual file; and

- Integrated data file.

The data required, and the manner in which the user will utilize the data, dictate the recommended data format. Note that how the data are used today in the "As-Is" environment may be significantly different from future "To-Be" requirements and formats. In some cases, such as legacy data, cost restrictions may preclude making the data available in other than Raster or page description language (PDL).

Determine What Data Interchange Standards Are Required

In order to ensure the proper sharing and exchanging of information across dissimilar systems, the PM must consider the possible loss of information when translating between software applications or from one data format to another (whether the format is standard or not). The following types of interchange standards are used with data formats listed above:

- Document image standards;
- Text standards;
- Graphics standards;
- Application unique/data standards; and
- Data transfer standards (i.e., e-mail and e-mail attachments).

The manner in which data will be utilized (manipulated, presented, and exchanged) impacts the acceptable set of data formats. Chapter 6 discusses the use of standard formats which do not always guarantee interoperability. Standards typically require a minimum set of compliance requirements, but permit additional capabilities. If all systems do not support the full range of capabilities, interoperability and file compatibility suffer. A simple, yet often experienced, problem involves text and graphics standards. MS-Word and WordPerfect files are compatible in that a document created in one can be read and manipulated by the other. However, if one user's document includes graphics, images, and/or tables, file exchange becomes much more complex. Often within an APDE implementation it is not only important to ensure that everyone has access to a given set of hardware/software applications and interchange standards, but that the manner in which the applications are used is consistent with interoperability and file compatibility across the infrastructure (to include users outside the PMO).

Determine the Mechanisms and Type of Media for Data Delivery/Access

Current acquisition guidance supports on-line access to, or delivery of, programmatic and technical data in digital form.[19] The PM needs to determine the data delivery/access media or mechanism requirements and ensure those requirements are specified through the statement of work (SOW), the CDRL, and specific Data Item Descriptions (DID).

Physical Media:

Magnetic tape is a mature, stable technology that is able to handle the large volumes of data typically associated with a major defense system acquisition. Magnetic tape standards are well defined, and little additional investment cost will be involved. However, other media may be more efficient and, therefore, preferred.

Magnetic disk is also widely implemented on personal computers and work stations and may be the physical medium of choice for small business contractors. Several primary

de facto magnetic disk formats are available but no official standard has been accepted. Compatibility problems exist, but can be overcome with only moderate effort.

Optical media is used here as a generic term to include Compact Disk-Read Only Memory (CD-ROM), Compact Disk Interactive (CDI) and Digital Video Interactive (DVI), Write Once and Read Many Times (WORM), and erasable optical disk. These media are ideal for mass distribution and archival purposes for large volumes of data.

Telecommunications:

Telecommunication networks provide an excellent opportunity to deliver, access, and exchange information. On-line delivery may be achieved via two methods: (1) delivery of CDRL items from a contractor sending system to a government receiving system via telecommunications download; or (2) in-place delivery, which allows data items to be stored and maintained at a contractor's site for retrieval and display via telecommunications using a government terminal, personal computer, or workstation. Secure, on-line transmission or delivery of the full volume of data for defense systems is technically feasible but often severely taxes telecommunication networks. On-line access, as distinguished from on-line delivery, refers to the situation in which an organization accesses data items through CITIS, or other similar information management services, as negotiated in the contract. On-line interactive access provides immediate and timely data access for custom report generation, document generation, and on-line request of information transmitted as composed products and processable data files.

Contractor Integrated Technical Information Service (CITIS):

A CITIS can be the backbone of a PMO's APDE, providing significant benefits to the PM. A CITIS clearly supports the spirit of emerging acquisition regulations and directives, including the DoD 5000.2-R goal of employing the "concept of Integrated Product and Process Development (IPPD) throughout the program design process to the maximum extent practicable."[20] While this goal specifically addresses the key tenet of IPPD as being Integrated Product Teams (IPTs), the CITIS provides the set of core information functions to facilitate the concept of "shared data" which is critical to IPT success. CITIS exemplifies the APDE and IDE vision of creating data once and using it many times and standardizes functional characteristics of the data to facilitate its usage by a wide variety of different users.[21] While an APDE implementation can exist without CITIS, it would be very limited in scope.

A variety of factors can influence the decision for a CITIS requirement, including program phase, data type and format, volume of data being delivered, lifetime of the data, the interchange standards required, and the cost to implement the system.[22] PMs need to understand the CITIS data infrastructure options being offered by their contractor(s) and examine the degree to which they support the PMO. Use of existing information systems and data formats [e.g., CITIS] is preferred over a government unique solution, providing it is compatible with operational DoD information systems and data.[23] A CITIS can play a key, if not essential, role in the success of the APDE, and meeting user's information requirements. Government access to data is of little value if the

manner in which the data are accessed, the ease and timeliness of access, the format of the data, and the systems supporting the use of the data, do not satisfy the user's needs. The *Military Standard, Contractor Integrated Technical Information Service (CITIS) 974 (MIL-STD-974)*, dated 20 August 1993, addresses CITIS functions which may be specified in the SOW and listed as contract line items.

Workflow Manager:

Data access, compatibility, interoperability, and system connectivity provide a basic framework with enormous potential. However, the To-Be infrastructure described by the APDE CONOPS must also address how information is processed, used, and shared. Simply making information more accessible and automating existing processes will not result in substantive benefits. Workflow managers enable the transformation from a common data environment to a true integrated process environment by providing the tool(s) to support real process improvement and reengineering efforts. Care needs to be taken to ensure that workflow managers planned within the APDE accurately reflect not only individual user data requirements, but also the process requirements of the Government/industry team as they will exist in the future.

Cost-Benefit Analysis

An APDE requires substantial resources to create and support. The amount of resources required increases with added complexity and capability. A cost-benefit analysis assists in determining the degree to which an APDE should be implemented. In some cases the implementation may appear severely constrained due to lack of resources. However, one may also find that the accumulated short- and long-term benefits of a digital infrastructure may more than compensate for the initial expense and operating costs. In any case, the effectiveness of the "To-Be" infrastructure, and the success of its implementation, depends upon the availability and commitment of resources by the PMO. A good plan that is not adequately supported in terms of time, management, personnel, and funding will not succeed. As a result, it is important to fully analyze all costs and benefits. This section is not meant to be all inclusive, but will serve to highlight areas that need addressing.

Identify the Costs:

These include both non-recurring and recurring costs listed below:

Non-Recurring (One Time) Costs:

Physical infrastructure—Changes necessary to support the APDE include physical remodeling, furniture, and increasing communications capabilities (additional phone lines, wiring, internal network installation, etc.).

Hardware—

Computers – individual, servers, data storage, etc.

Monitors – in many cases, standard 15-inch Super Video Graphics Array (SVGA) monitors are less than optimal or not sufficient to meet user requirements. Full page documents, or technical drawings, must often be readable on-screen. If they are not, the user resorts to printing, which negates some of the advantages of a digital environment. This is typi-

cally true of technical drawings. In several cases research shows the PMO and contractors have identified that, based upon user requirements, the added expense of larger and higher quality monitors is well justified.

Printers/plotters – moving to a digital environment does not eliminate the need for paper. The ability to go from soft-copy to hard-copy is important. One concern is that offices with a hard-copy capability will "print everything anyway." However, research finds this is not the case. Organizations with adequate hard-copy capability tend to be more receptive to working in a digital environment, feeling secure that a hard-copy is always available when necessary. Organizations with limited printing capability tend to be more inclined to request and use paper (and the trusted copier). In addition to examining the need for hard-copy devices, output format size, resolution, memory, and color requirements need addressing.

Network connectivity – this includes connections, network cards, installation of a LAN, WAN, or other network environment. It also includes the purchase of modems or other network communications devices.

Software – Includes the acquisition of commercial and government software that promotes functional capabilities, data management (storage, access, retrieval, maintenance, etc.), interoperability, and systems integration.

Data Conversion – Conversion of data from existing legacy form/format to something that is useful in the "To-Be" environment. The PM needs to carefully identify exactly what data requires conversion, the type of conversion that is necessary and useful, and the most cost effective way to make it happen.

Personnel – Initial education and training will be required and should be planned for. In some cases the organization may change substantially, requiring specific individuals or skill sets to be added. As processes or functions change or become more efficient, various personnel requirements linked to the As-Is infrastructure may no longer be required. Associated personnel costs should be identified.

Recurring Costs:

Hardware/software – There is a continuing requirement for maintenance and upgrades, such as site licenses, user fees, and support contracts. Several interviewees stressed that the APDE should not and cannot be static. Planned upgrade or replacement of hardware every 2-3 years and software every 18 months needs consideration.

Communications – Monthly fees for digital links (i.e., ISDN, T-1), long-distance services, and dedicated lines.

CITIS – Access fees, support, and maintenance requirements

External services – As with any infrastructure, reliability and effective maintenance are essential. System administrators, help-desks, and other user support services may be needed.

Personnel – Training, cross-training, and skill development, are ongoing requirements. This is particularly true in a dynamic digital environment where people change, hardware and software capabilities evolve, and processes improve.

Benefits:

An APDE can provide enabling capabilities that support substantial cost savings, cycle time reduction and management efficiencies. Chapters 3 and 4 highlight these benefits. Within DoD there are few available metrics and/or incentive programs that offer definitive benefits. Chapter 6 delves into this issue. However, while it is difficult to accurately quantify the benefits of an APDE in terms of dollars, the PM needs to examine its potential value in terms of quality and productivity. In some cases the issue is not the benefits that can be attained through an APDE, but the potential increased life cycle costs if an APDE implementation is not undertaken. With budgets becoming increasingly constrained, exploiting the advantages of an APDE becomes a significant requirement if the program is to even survive.

Define the "To-Be" Infrastructure

Prior to implementing an APDE, it is critical that the PMO clearly articulate the "To-Be" infrastructure and lay out the road map for the transition. In a military environment, a clear articulation of the "Commander's Intent," or vision, is perhaps the most critical component of a mission order. This is also true when accomplishing objectives within an organizational structure, and especially the case when evoking significant organizational and process change which occurs as a PMO moves toward an APDE. Research shows the ease of implementation increases dramatically when individuals at every level of the organizations have a clear understanding of the goals, objectives, implementation plan, schedule, and the "To-Be" organization. This not only reduces cultural resistance within the organization, but also improves awareness and cooperation between management, system developers, contractors, and users. Data clearly validate that the most effective mechanism in communicating the APDE vision is through the early development of a document resembling the APDE CONOPS[24] or its industry equivalent, and the broad dissemination of its contents. The CONOPS should clearly define the "To-Be" infrastructure, its goals, and how the organization will get from where they are to where they are going.

Leading Organizational Change

The PM is responsible for addressing the questions and concerns of those within the PMO that relate to APDE implementation. Cultural resistance to change is a most difficult challenge. As the PMO moves toward an integrated digital environment, significant opportunities arise for process improvement and functional reorganization. Change is inevitable—it reduces comfort levels throughout the organization and often elicits a backlash of resentment and resistance. "That's the way we've always done it" is difficult to overcome in most organizations, particularly for those well indoctrinated in a relatively stable system that is familiar and offers physical, emotional and employment security.

Management Buy-in

The PM, industry, and government agency counterparts must gain buy-in throughout their respective organizations. This includes those internal to the organization, external people with relationships to the organization (government and contractors), remote support activi-

ties, and other users. Failure to do so impairs the APDE effort. Smooth change can only be accomplished when top level and front line employees are committed to the initiative. Top level employees typically demonstrate their commitment by being visibly involved.[25] Demonstrating commitment at all levels of management is a key success factor.

Keep Everyone Informed

The APDE effort needs to be understood to be accepted. Not only does this reduce cultural resistance, but it also promotes employee involvement and commitment even at the lowest levels, leading to significant, previously unplanned, improvements. "It is important for those who will be affected by the implementation [of the APDE] and the resulting process improvement to understand how the effort will unfold and how it will affect them as individuals."[26] While the APDE CONOPS tends to provide a top-level view, management needs to articulate how the APDE impacts individual processes and users. Are jobs at stake? How will this effect the way I do business? Exactly why are we doing this? Where are the benefits? These types of questions need answering. The PM must make people fully aware of the vision and its goals, get them actively involved in the process, increase commitment at all levels, and promote the generation of new ideas that might otherwise be overlooked. One method that has been used is to conduct workshops prior to and during implementation to open new lines of communications. This helps to identify barriers, promotes user buy-in, and enhances the planning process.[27]

Follow Through

The development and success of an APDE requires continued commitment on the part of program leadership and management throughout the data user community. The timeline, resource, training, and infrastructure requirements outlined in the APDE CONOPS requires continually monitoring to ensure initial planning assumptions are accurate, sufficient resources are being committed, and the goals and objectives are being met.

Summary

This chapter examined the development of an APDE from a PM's perspective. A detailed description is provided for developing an APDE CONOPS, which is perhaps the most critical part of the process. The CONOPS provides the framework for the APDE effort; a road map for implementation; and addresses the acquisition program goals and objectives. It examines user and process data requirements, and describes how those requirements will be met. The APDE CONOPS clearly articulates the overall vision, and thereby enables everyone involved in the process to better understand and support the effort.

ENDNOTES:

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17. Figure derived in part from DoD CALS Office Program manager's desktop guide for continuous acquisition and life-cycle support (CALS) implementation, Figure 5-2 (September 1995); and from the Military Handbook, MIL-HDBK-59B, Continuous acquisition and life-cycle support (CALS) implementation guide Figure 4. (June 10, 1994).

18. Table found in the Military Handbook, MIL-HDBK-59B, continuous acquisition and life-cycle support (CALS) implementation guide, p 13. (June 10, 1994). Washington, D.C.: Author.

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24. Combat Mobility Systems (CMS). (March 1996). Interim lessons learned for PM, CMS IDE implementation. Unpublished paper submitted for this research report by the CMS PMO, p 3. Warren, MI: Author.

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6

ISSUES FACING THE DEPARTMENT OF DEFENSE

This chapter addresses some of the issues surrounding the exploitation of the digital environment within the Department of Defense (DoD) Acquisition Community, and discusses recommendations for Program Managers (PMs) to consider. They include:

- Lack of a *single face* to industry;
- DoD-wide integrated data environment (IDE) efforts are led by the logistics community;
- Lack of a DoD-wide infrastructure;
- Use of standards;
- Continuous Acquisition and Life-cycle Support (CALS) "compliance";
- Education and training;
- DoD implementation guidance;
- Incentives and metrics;
- Data requirements: access, delivery, and use; and
- Cultural barriers.

The degree to which they impact a program management office (PMO) will vary depending upon the program and its Acquisition Program's Digital Environment (APDE) implementation. However, it is important that the PMO at least be cognizant of these issues in order to mitigate their potential impact.

Issue: Lack of a *Single face* to Industry

While many advocate the concept of presenting a *single face* to industry, the fact is that the numerous agencies involved in various aspects of the digital business infrastructure precludes a singular coordinated effort. Within DoD, Electronic Commerce/Electronic Data Interchange (EC/EDI) falls under the responsibility of Deputy Under Secretary of Defense (Acquisition Reform) (DUSD(AR)) and has centered on the contracting community and automating procurement processes, particularly transactions under $100K. The CALS effort within Deputy Under Secretary of Defense (Logistics) (DUSD(L)) has a logistics and sustainment focus, although its vision is to support cross functional data integration across the program life cycle. The development

of standards and the data exchange infrastructure is led by Defense Information System Agency (DISA).

There are also other government and industry players involved in the development of standards and policies, such as the Department of Commerce (DoC), National Institute of Standards and Technology (NIST), industry steering groups, and national and international standards bodies. While there is clearly discussion and cooperation between the involved organizations, there is also a lack of oversight and enforcement with respect to conflicting or overlapping functions and responsibilities. Most of our interviewees cited that these apparent functional stove pipes or "rice bowls" at the top result in confusion and lack of clear guidance or direction at the grass roots level. Not only does this preclude a *single face* to industry, but it also prevents the DoD acquisition workforce from understanding the mission, objectives, goals, and requirements. The answers change depending upon who responds to the question. A recent independent study highlighted similar concerns within DoD and industry:[1]

- numbers of seemingly uncoordinated demonstration and pilot projects;
- the perceived lack of central oversight and monitorship;
- inadequate and poor communications between the community, PMOs, users, and customers;
- constant personnel change-over within government (military and civilian) which provides little consistency and long-term vision;
- inadequate or incomplete requirements for interface; and
- lessons learned, success stories and major systems implementation status using digital data are not widely disseminated.

This "functional" approach to digital infrastructure development within DoD also results in a non-integrated approach at the Service and program levels, and extends to industry. In an Army pilot program after action report, it was noted that "[we] experienced extraordinary levels of frustration while trying to discover where in the Government bureaucracy the solutions to daily problems could be found."[2] While they went on to say that "IDE advocates at high levels within DUSD(L), DISA, AMC [U.S. Army Materiel Command] and PEO [Program Executive Office] ASM (to name just a few) have been instrumental in the successes achieved to date," it remains that a single focal point, or *single face* to the acquisition community is lacking.

Despite the goal of a cross functional "integrated" digital environment, research finds the Services, PMOs, and industry partners each to be mirroring the functionally segregated DoD organizational structure. In most cases, different offices are responsible for program management, digital infrastructure issues, CALS issues, and EC/EDI issues. Offices are typically separated, both physically and functionally, and often not cognizant of what the others are doing. This appears to happen because at the DoD-level, guidance and policy are typically disseminated through the different functional chains such as PEO/acquisition, logistics, or contracting.

Recommendation

At the PMO level, it is important for the PM to take a total systems approach, examine how the functional and business processes interact, and plan for the entire information life cycle

of the program. While there is little a PM can do about the assignment of responsibilities within the DoD and the Service hierarchies, the PM can ensure that efforts controlled by the PMO are coordinated. A major step is to establish a clear APDE vision through a Concept of Operations (CONOPS). (Refer to Chapter 5 for a discussion of CONOPS.) Functional boundaries that act as barriers to information exchange and coordination must be eliminated, wherever possible. The efforts of everyone involved in the development and evolution of the APDE, especially industry partners and support agencies, need to be consolidated and coordinated. The result is a single shared vision of the APDE that is understood and, hopefully, supported by all concerned.

Issue: DoD-wide IDE Efforts Are Led by the Logistics Community

The development and support of the DoD-wide strategic IDE vision is the responsibility of the CALS office under DUSD(L). Unfortunately, DoD has been unable to refocus the reputation of CALS from a logistics effort to one that supports the entire acquisition community.[3] PMs and industry counterparts interviewed consistently viewed IDE/CALS efforts as logistics initiatives. Even today, as the CALS office attempts to embrace total life cycle support, which includes development and initial acquisition, the CALS efforts at DoD and the Service levels are managed by the logistics community and focus on post-production maintenance and sustainment activities.[4] In the Advanced Program Management Course (APMC) at the Defense Systems Management College (DSMC), CALS and IDE are taught as a logistics elective. As a result, many on the materiel acquisition and program management side tend to relegate CALS issues to their senior logistics personnel. Industry counterparts often mirror this organizational structure.

Recommendation

At the DoD and the Service levels, the placement of CALS/IDE efforts under the logistics chain effectively precludes them from directly influencing the PM. Research findings provide many examples of programs attempting to move toward an APDE. In most cases their approach closely parallels the commonsense approach of the CALS office, but is followed without knowledge of, or coordination with, the DoD or the Service CALS organizations. While much credit goes to the logistics community for attempting to develop an environment that supports a cross functional digital integration effort, making it happen is a PM's responsibility. The logistics community or the senior logistician within a PMO, for the most part, lacks training, experience, responsibility, and program authority to bring all these various functions, activities, and processes together. That is the job of the PM and is achieved through partnership arrangements with industry and other DoD agencies. Thus, at the PMO level, it is imperative that IDE/APDE efforts not be focused solely around logistics requirements.

Issue: Lack of a DoD-wide Infrastructure

The DoD does not have an adequate infrastructure in place to access, receive, manage, or effectively use data digitally delivered by the PMO.[5] This is a problem that has been identified repeatedly over the past several years.[6] The vision of a DoD-level IDE necessitates an infrastructure that is capable of handling digital data. Research shows repeated instances where programs are attempting to transition to a digital environment only to be stymied by support systems or processes that are still entrenched in paper-based rules. Work orders, program actions, and purchases can be held up for days or weeks because someone still re-

quires a printed document with an original signature. Information exchange is unreliable or ineffective because of incompatible file transfer mechanisms or inadequate communications links. Digital data, documents, and technical drawings are incompatible with the format required or desired by a support agency. In one case the government is paying a prime contractor to sub-contract the conversion of digital drawings (vector/computer-aided design (CAD)) to aperture cards because they have "always required drawings on aperture cards."[7] At the same time, the government was taking aperture cards and paying to have them scanned and converted to digital form. These second or third generation raster scanned drawings not only increase overall cost, but also have lower resolution and contain far less useful information than the original vector drawings.

The requirement for aperture cards is largely being eliminated in all the Services. These simple examples highlight how the lack of a common DoD-wide infrastructure for digital data negates many advantages of an APDE or DoD-wide IDE. If the contracting office, contractor, user, finance, procurement, or logistics chain cannot support digital data, PMs must resort to paper. This not only incurs additional cost, but limits the potential benefits that the APDE can achieve.

Recommendation

The PM has several commercial off-the-shelf (COTS) and government off-the-shelf (GOTS) hardware and software options available, as well as contractor developed solutions, to effect an integrated digital environment that supports the program. Government development efforts such as Joint Computer-aided Acquisition and Logistics Support (JCALS), Configuration Management Information System (CMIS), Joint Engineering Data Management and Information Control System (JEDMICS), and Federal Acquisition Computer Network (FACNET) may be of value or they may clearly not be preferred when compared to more current commercial products and systems. Whatever path the PMO chooses to take, the key to success is a focus on integration, interoperability, and a clear migratory path to the future. These are supported through the use of national and international standards, practices, and technologies to automate the management and exchange of information. Current standards (see Appendix B) supporting the IDE and APDE have the ability to grow as requirements change. A path for planned migration is essential to the success of an APDE implementation. While there may not be an existing DoD IDE infrastructure in place, it has clearly been established that the future infrastructure will employ standards and standard business practices wherever possible. The APDE must be designed such that it too has an evolutionary path that will support an ability to adapt to future requirements and standards.[8]

Issue: Use of Standards

Many organizations involved in EC/EDI and IDE are relying on the use of standards and accepted commercial practices to provide data compatibility and system interoperability. Indeed, the adoption of commercial products, standards, and practices will "help to ensure maximum integration of the information infrastructure for weapon system acquisition management and support."[9] The use of common standards, however, does not always enable an acceptable level of integration or interoperability. Most standards are developed with inherent flexibility designed to support additional requirements, future growth/migration, and the ability to tailor the standard to specific or unique applications. In some cases, this flexibility in fact detracts from data integration

efforts, particularly where fields or implementation capabilities are optional or conditional. Numerous instances exist where government agencies and industry continue to use different implementation conventions, and thus are unable to exchange data.[10] Typically, GOTS or COTS packages support specific user requirements and do not support every option embedded within a standard. When one agency chooses to utilize optional fields different from another agency, there is an information disconnect. A DoD supplier notes that one installation requires the use of a given standard for data exchange, but because the standard is applied differently by different organizations, the net effect is that the supplier has to do business three different ways.[11] The DoD offices are each using valid applications of the standard. While the differences in implementation are subtle, including version differences and optional/conditional fields that are not universally supported, they have a compounding negative effect on the supplier.

DoD is a strong advocate of commercial practices and standards, but shows reluctance in dictating exactly which practices or standards must be used and how they should be incorporated into an acquisition program. Applying strict requirements immediately ties the PM's hands and limits available options in an evolving business environment. However, failing to specify a given standard or implementation causes discontinuity between organizations and agencies that, by their very nature, require data compatibility and integration. Requiring DoD agencies or contractors to support all possible variants of the different standards is an unnecessary imposition and not cost efficient. As one major Defense contractor stated, "All of our data is digital. If DoD would just tell us exactly how they want the data, we could easily give it to them that way and it would save a lot of time and money."[12]

Recommendation

The PM cannot simply rely on standards to ensure interoperability and data compatibility. In identifying data requirements for an APDE, one must at least be aware of how standards are applied by each user, specifically in the area of data elements, formats, and interface protocols. Interoperability issues need addressing up front, either by way of dictating specific standards applications or through the use of data translation mechanisms to provide a reliable interface between two seemingly incompatible data systems. As one PMO expressed, "a PM should identify what we call our 'least common denominator' (LCD) for all file formats. This means that if an individual has the capability to send/receive in all of the formats specified in the LCD, he can effectively participate in the various teams."[13] Different formats to address include such things as e-mail and attachments, word processing, spreadsheets, graphics, engineering drawings, and scheduling information.

Issue: CALS "Compliant"

During the research interviews, the term "CALS compliant" was used in many different ways. Some organizations claim to be CALS compliant because they are using commercial products, technology, and standards. To others, CALS compliant infers the use or planned employment of the CALS flagship programs (JCALS, JEDMICS, and CMIS). The DoD CALS office indicates that "CALS compliant" has no meaning *per se* because CALS is a strategy, not a program. CALS involves the exploitation of an evolving set of standards, practices, and technologies and does not lend itself to a fixed architecture or "compliance" certification.

Contractors and PMOs alike are implementing commercial standards, practices, and tech-

nology to develop integrated digital environments. In many cases this is done without an understanding of the CALS initiative or its DoD IDE strategy. However, there is still "a lack of a conformance testing process to ensure compliance with a standard."[14] Flexibility within standards (addressed above), and unique features embedded in individual applications, often result in system incompatibilities. In many cases the degree of interoperability between separate systems, both employing the same "standard" and designed to work together, is often unknown until the systems are actually in place and tested. Another common problem is COTS packages that are considered compatible, but only under given circumstances. A simple example, but one that is cited repeatedly, is with word processing software; MS Word and WordPerfect are compatible since each can import and manipulate the files of the other. However, in many cases when these files contain imported database files, graphics, or perhaps even audio clips, they become incompatible. Another common problem is in transferring data between organizations via e-mail, where file attachments are often treated differently depending upon the commercial product.

Recommendation

Unless specific standards for system and interface interoperability are established, these types of problems will persist. In the absence of such requirements from the DoD-level, the PMO needs to ensure that interoperability requirements and specifications are clearly defined in the APDE implementation plan or CONOPS. Compliance standards and performance specifications relating to the digital data infrastructure between government agencies needs addressing, and should be clearly articulated in contracts with industry.

Issue: Education and Training

Each PM within DoD, and in many cases their industry counterparts, have little training or experience in the area of increasing efficiencies through the use of information technology. During interviews, all PMOs highlighted the fact that personal professional development was inadequate for developing anything resembling an APDE. Training of the acquisition workforce on digital environment issues is largely left to the Services. Little is done at the DoD-level to ensure that the Services are even conducting training on CALS/IDE/EC/EDI, or the adequacy of that training. As the Service CALS offices are located in the logistics arena, training and information dissemination is confined mostly to the logistics community. Integrating processes and crossing functional boundaries between management, logistics, engineering, manufacturing, and contracting is sporadic. Within the Defense Acquisition University (DAU), CALS and IDE materials are taught as a logistics function, although they are currently studying a transition to program management and systems engineering. The same functional separation is true of EC/EDI initiatives; currently they are treated separately from the IDE, led by Acquisition Reform, and focus on contracting and procurement.

The problem, in part, appears to be the lack of an effective mechanism for the relevant DoD agencies to get the information to the PM or entrenched within the PMO. The leadership in both the DoD CALS and the DoD EC/EDI offices express a sense of frustration over the inability to get the message to the acquisition community, despite a concerted effort. The DoD CALS office recently produced the *Program Manager's Desktop Guide for CALS Implementation*, an interactive CD-ROM that provides extensive background and information on CALS, the IDE, standards, and top level

guidance for implementation of an APDE/IDE.[15] Unfortunately, even on occasions where PMOs or contractors have the Desktop Guide, it is typically in the possession of a logistics manager and receives little, if any, use. The CALS Industry Steering Group (ISG) also sponsors a CALS symposium each year and actively seeks participation by PMOs, DoD agencies, and industry. Here too, attendance is largely confined to the logistics community. There have been numerous EC/EDI information dissemination efforts by DUSD(AR). One example is the *Introduction to Department of Defense Electronic Commerce: A Handbook for Business*. Yet the EC Office still admits that the information does not appear to reach the people who need to understand.[16] Getting the word out to PMOs has largely been left to the Service Acquisition Executives (SAEs) and the DSMC, both of whom interact directly with the PM. Unfortunately, neither the Services nor DAU have developed an integrated approach to educating the acquisition community on exploiting the digital environment from a cross functional perspective.

Recommendation

An APDE has significant potential to improve processes, increase efficiency, save time, reduce cost, and improve performance. Unfortunately, most within the acquisition community have little experience or expertise in this arena. Education and training enables the organization to understand the concepts, appreciate the technology, recognize the potential, support the objectives, and then realize the benefits. In the absence of a well developed training program at the DoD-level, PMs need to recognize the importance of having a knowledge base within the PMO and industry partners. Training at the program level can be the key to a successful APDE implementation with inclusion of the following areas:

- formal training;
- information sharing between organizations; and
- working with other DoD/Service agencies and PMOs.

Issue: DoD Implementation Guidance

Acquisition guidance and direction stipulates on-line access to, or delivery of, programmatic and technical data in digital form[17] and the use of electronic media.[18] But DoD has purposely avoided requiring specific implementations or standards in its efforts to allow the PM maximum flexibility. (Refer to the paragraph on Use of Standards, above.) This permits and encourages the PMO and its industry partners to seek innovative solutions and exploit the digital environment in new and creative ways. However, it also allows less resourceful PMOs to implement solutions that may satisfy the letter but not the spirit of the DoD digital acquisition initiatives. The result is that the development of a cross functional digital infrastructure that supports the full life cycle of a weapon system (i.e., an APDE or IDE) is largely optional. Further, due to the lack of a substantive set of metrics or decision tools with which to perform a true cost/benefit analysis, the decision at the program level can be highly subjective. In some cases it can be argued that the creation and maintenance of such an infrastructure will conceivably increase life cycle costs, particularly in the short-term. As a cross functional APDE may well be resource intensive, particularly in the initial development stage, it is easy to see why PMs might elect not to implement. Even where the digital access or delivery requirement is met, this does not necessarily infer that it will support the future goals of an IDE and significant life cycle cost savings. A 1994 GAO report highlights: “It is of para-

mount importance that Defense decide how it wants to change the current way it does business and not merely automate existing practices."[19]

Recommendation

PMs must focus on the intent, in addition to the letter, of the new Defense acquisition regulations and guidance. They need to understand the opportunities for process improvement and reengineering within PMOs and the role that an integrated digital environment plays in enabling such efforts. The PMO needs to go beyond using digital technology for its own sake, and examine how this technology is useful to reengineer ways in which they conduct business. In order to truly achieve substantial cost savings and improvements in efficiency, an evolving APDE must address the fundamental questions of data acquisition, maintenance, access, and use across the entire life cycle of the program. Mirroring existing functions and processes will not get the job done and may, in fact, increase costs. This may involve very difficult decisions because current DoD regulations leave the degree to which the PMO implements an APDE or IDE totally to the discretion of the PM. The "optional" nature of an integrated APDE is furthered by the fact that DoD does not provide formal funding or administrative infrastructure support for digital integration efforts.[20] However, PMs need to be aware that implementing the DoD vision, or more specifically the development of an APDE-like environment, has inherent benefits and makes good business sense within a PMO. The application of existing national and international standards, practices, and technologies is evolutionary.[21] They enable process improvements and reengineering efforts that provide substantial returns on investment (ROI) throughout the entire program life cycle. It is truly the hope of DoD and the leadership within the acquisition community that the lack of fixed requirements regarding digital integration efforts will be seen by the PM as an opportunity rather than a limitation.

Issue: Incentives and Metrics

Implementing an integrated APDE, and the degree to which it supports the full life cycle of the program, is largely up to the discretion of the PM. Other than DoD guidance that generally supports a digital environment, we found that there are no real incentive programs to encourage PMs to implement an APDE/IDE.[22] Most APDE benefits: cost savings, shorter cycle times, increased access to shared data, and an improved management infrastructure, are realized after a substantial initial resource commitment. Since PMs are typically assigned for relatively short periods of time, they often do not see the APDE program rewards. This is somewhat true, though to a lesser degree, in industry where promotions and bonuses are often tied to visible short-term cost savings or increases in profits. Within DoD, PMs are primarily evaluated on achieving milestones and staying within budget. An historical problem is that even where PMs recognize the advantages of an integrated digital environment, they are often reluctant to spend scarce program dollars for 'potential' future and long-range benefits,[23] particularly in today's environment where programs are becoming increasingly budget constrained.

There has also been a problem with identifying metrics or evaluation tools that can support a valid APDE cost-benefit analysis. Many industry leaders in this area are reluctant to reveal specific details as it offers a source of competitive advantage. Also, much of the cost savings seen in industry results from corporate downsizing—enabled by process improvement and reengineering. Personnel costs are a

major factor in the business community. While a PM may be able to improve efficiency and streamline processes, they often do not have the ability to follow through with the next logical step of reducing personnel overhead costs within the PMO or support structure. Cutting administrative requirements by 50 percent is of little value if the administrative office must still operate at 100 percent personnel strength. A PMO that no longer requires two floors of a building, probably cannot reduce costs by selling or sub-leasing the space. Despite these limitations, if the cost of developing and implementing an APDE cannot be directly linked to cost savings, it is difficult to justify.

At the DoD-level, there has historically been a lack of "lessons learned" or sharing of experiences that would assist a PMO in evaluating the potential benefits and justifying the expense of an APDE.[24] As one official cites, a problem with "acquisition PMs, and especially the money counters, is when we try to 'sell them' on the idea that some money invested now in digitizing data and applying some CALS standards up front will yield a 'profit.' We just don't have the hard data, evidence, or metrics to back up our claims."[25] There are PMOs exploiting the digital environment in a variety of ways and with differing degrees of success. Unfortunately, their experiences are not well documented or available to other PMOs wishing to explore similar opportunities.

Recommendation

There are several efforts underway to address incentives and metrics. Incentives and support for APDE-related initiatives differ between the Services. The acquisition community, notably the CALS and EC/EDI offices, are actively involved in developing lessons learned and real-world metrics to support PMO efforts. However, there are presently few DoD examples that have been well documented. Most of the benefit models in use today are based upon commercial examples, which may not be fully applicable within a PMO. In the near term, consult with other PMOs, as well as with the Services and DoD agencies, to identify metrics and incentive opportunities. Carefully identifying and examining the benefits enabled by a digital infrastructure in order to justify its implementation is essential. In some cases these can be directly linked to cost savings. In others, the benefits are less tangible yet equally important.

Issue: Data Requirements: Access, Delivery, and Use

Historically in a paper-based environment contract data requirements list (CDRL) items were identified by the government, and the contractor made physical delivery of documents and drawings that the government stored and maintained for future use. This was particularly true of technical data; the totality of data required to design, analyze, manufacture, test, inspect, and sustain end items.[26] In today's highly technical digital environment, questions arise as to the utility of the government requiring physical delivery of documents and technical data. New acquisition regulations clearly state a preference for "on-line access to contractor developed data through contractor information services rather than data delivery."[27] Even where data are required for competitive sourcing of system support, the general direction is for the PM to provide for long-term access to the data, which does not necessitate physical delivery.[28]

Care is necessary to ensure that the PMO understands what data/information are required in order to develop, produce, manage, and maintain the system. However, it is also important to understand what is not needed. In the past, concerns over not having enough in-

formation when it was needed led to a "we need everything" mentality. These deliverables are not only costly but result in mountains of paper that require storage and maintenance, which again adds to the government's burden. In a digital environment, virtually everything relating to an acquisition program is created on a computer: documents, drawings, status reports, requests, proposals, contracts, briefings, financial information, etc. There often is a greater temptation to ask for everything simply because it appears to be readily available.

Buying too much data can be as costly, if not more so, than buying too little. PMs need to make early examination to ensure CDRLs: "represent the minimum essential to effectively support the fielded system."[29] In some cases, concerns arise over data that may never be used, but under certain scenarios the lack of that data might prove critical. In these situations the PM must determine the best way to support the system and the user. This is done by including the user and maintainer in the decision process as part of the APDE CONOPS development process. If the data are not required today, can it be accessed down the road? In some cases CDRL items, notably technical drawings, that are routinely delivered early in the development cycle, now perhaps are better left with the contractor and accessed only when needed. This is particularly true where modifications to drawings or components are ongoing. What is the life cycle cost of the data as compared to the cost of not having the data at a later date? Many questions need to be asked to ensure that prudent decisions are made. The Federal Advisory Committee Act (FACA) and DoD 5000.2-R recommend the PMOs take advantage of industry expertise,[30] contractor personnel, to improve the acquisition strategy. They, along with functional experts within the PMO, the DoD support structure, and the user community can help identify areas where data requirements are not essential or data support can be improved. In the past, many data requirements were levied as a matter of routine. Today's acquisition reform initiatives stress that the PM take a commonsense approach to all aspects of the acquisition cycle. "Relief or exemption shall be sought for those requirements that fail to add value, are not essential, or not cost-effective."[31]

Integrating functions within an acquisition program is only the first step. In addition to coordinating the efforts of logistics, contracting, transportation, and other functional communities, further efforts to integrate data requirements and streamline processes at the DoD-level are necessary. This means not only to get organizations working together, but to get functional organizations to examine their ways of doing business and consider how to improve efficiency. One office lamented that if you digitize technical manuals, but are still required to go through 14 different offices in order to get changes approved, you are still working in the dark ages.

Example: When identifying data requirements, it is equally important to identify opportunities for process improvement or reengineering. In many cases, data requirements and serial processes are generated by actions that may no longer be justified or needed. A familiar example is with government business travel. With its strict rules for maximum allowable per diem (lodging and miscellaneous) and reimbursable expenses, processing of travel vouchers lends itself extremely well to automation. The numbers do not change, the rules for applying those numbers do not change, and there is little need for human intervention or judgment in the process. However, in most organizations, the following occurs: (a) Individual prints, reproduces, and submits multiple copies of the voucher, travel orders, tickets, and

receipts over $25; (b) the voucher is reviewed and signed by a supervisor/approving officer (two signatures required if an official phone call is made); (c) local travel office reviews voucher submission, maintains a file copy, and mails the completed packet to the processing finance office; (d) finance personnel manually process the voucher for settlement (note: computers actually process the settlement. However, because the voucher is in paper form, the information requires manual input into the computer. For the settlement to be processed correctly the information must be transferred without error); and (e) the settlement voucher is mailed back to the traveler.

While this is not a defense acquisition specific example, it does highlight how the age old requirements dictating serial processing can hamper streamlining goals. Each step cited above (with many steps omitted) adds time, cost, and potential for errors to the process of a travel voucher settlement. Many of the steps add no real value to the process. In fact, some clearly detract from the process. Automating the current serial functions would save both time and money, and reduce the potential for errors. However, *integrating* the processes could do significantly more. Imagine a travel request that automatically enabled not only the generation of travel orders, but also scheduling of transportation and lodging through the local travel office and a return receipt of itinerary on-line. Turn around time decreases dramatically, as does administrative support costs. Allow vouchers to be submitted on-line and the result would again decrease completion time, reduce processing cost, cut cost of paper and copying, and cut mailing costs. Why does a finance officer hundreds of miles away need to physically see a copy of a hotel bill? One U.S. Department of Treasury official spoke of a similar system they have installed that results in employee electronic reimbursement 2-5 days after return from travel.[32] To further integrate the process, official charges to the Government American Express card, listed on the travel voucher, could be paid directly to American Express. There is little doubt that American Express would be interested in working jointly with the Government to support such a concept, and perhaps be willing to bear part of the development burden as part of a "shared savings" concept.[33] Currently, charges to American Express are paid on the average of 20-50 days after they are incurred. Under a direct on-line payment system American Express could conceivably cut that average time to under 10 days, a 50-80 percent reduction. The "cost of money" savings alone would be significant and perhaps warrant financial consideration during contract negotiation with the Government charge card supplier.

Recommendation

The PM needs to ensure government data needs are met to secure critical information on weapon system design, development, manufacture, reliability, maintainability, and support. Once those data requirements are identified, the PM then determines whether the government's needs are best satisfied by delivery of the data, preferably in digital form, or access to a contractor maintained database. The PM examines data requirements from a total system life cycle perspective, with a clear view of short- and long-term costs and risk mitigation. What is the cost of data delivery with associated government storage and maintenance burden, as compared to government access to a contractor repository? What are the benefits? Sometimes the technical or proprietary nature of a design effectively means any further modification or manufacture will be performed by the original contractor. In this case, configuration management is arguably best performed by the Original Equipment Manufacturer

(OEM) as opposed to a government agency. The most up to date information about the part, design, process, or manufacturing technique would clearly reside at the contractor facility, and likely differ from that originally delivered to the Government weeks, months or years before. Minimizing data duplications, redundancies and inconsistencies is a clear objective. Both the PMO and industry partners should examine the potential for process improvement and reengineering initiatives enabled by the APDE, realizing substantive savings wherever possible.

Issue: Cultural Barriers

An essential area to address when implementing significant change are cultural barriers; both internal and external to the PMO.[34] The syndrome—"That's the way we've always done it" is difficult to overcome in most organizations, particularly when dealing with managers and users who have grown up within a relatively stable environment. As a program moves toward an advanced APDE, significant opportunities arise for process reengineering and functional reorganization. This reduces comfort levels and often elicits a backlash of resentment and resistance.

Recommendation

The success resulting from the exploitation of an APDE is directly related to the commitment of the PM and leadership within the PMO. (See Chapter 5 for a detailed discussion of negotiating the digital environment and leading organizational change.) Several persons stated the lack of a focused and integrated approach to an integrated digital environment is clearly attributable to leadership unawareness or uninvolvement in the process. Within a PMO, effective leadership and perseverance is critical to overcoming cultural barriers. The PM clearly identifies the vision; where we are, where we are going, and how we intend to get there. The PM must get buy-in from functional and process managers, staffs, and the ultimate users. When dealing with the psychology of change, those who are not committed to being part of the solution, potentially become part of the problem. Committing the resources (money, time, training, and personnel) on the part of the PM clearly demonstrates personal commitment and fosters similar commitment throughout the organization.

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23. Office of the Inspector General. (June 8, 1994). Management of digitized technical data inspection report, p 11. (IG Report No. 94-INS-05). Washington, D.C.: U.S. Government Printing Office.

24. Numerous interviews and documents reinforced this idea.

25. Interview with a DoD CALS official.

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7

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This report provides a comprehensive overview of the exploitation of digital environments within the Defense acquisition community. It concentrates on the development and benefits of an Acquisition Program's Digital Environment (APDE), a cross functional integrated digital environment that links all stakeholders within a particular acquisition program. This research describes the environment, discusses the benefits in terms of competitive advantage and process improvement, examines the experiences of industry and the Department of Defense (DoD), provides a methodology for developing an APDE, and addresses some of the many issues affecting the program manager (PM).

DoD acquisition programs will significantly benefit from the systematic development of an APDE. Such an undertaking is really a necessary precondition to achieving the optimistic goals of Acquisition Reform. Transition to a digital environment should not be considered an option. Clearly, from both commercial experience and Defense policy, the Defense acquisition community needs to embrace the information age, exploiting opportunities for process improvement and reengineering, if they intend to operate faster, better, smarter, and cheaper.

In order to fully exploit the digital environment, the Defense acquisition workforce needs proper organization, training, and top leadership support. An impediment to the development of a truly cross functional APDE is the apparent stove pipes that exist, precluding the clear articulation of a DoD ***vision***. Current efforts to advance digital environments within the acquisition community are led independently along functional lines under Logistics (Continuous Acquisition and Life-cycle Support (CALS)), Acquisition Reform (Electronic Commerce/Electronic Data Interchange (EC/EDI)), Office of Defense Procurement, and various Service and independent program management office (PMO) initiatives. With additional involvement by Defense Information System Agency (DISA), and other DoD and Government agencies, there is no *single face* to the acquisition community or industry. More importantly, by focusing on functional areas, none of the major initiatives truly address the information needs of the PM, and thus are

viewed as having little significance to the PMO. Further, education and training are also functionally based and generally considered inadequate, which exacerbates the problem.

Acquisition programs throughout DoD are using digital technology to varying degrees. However, there is still much that can be done to move the acquisition community into the information age and support efforts to exploit the benefits and potential of the digital environment.

Recommendations

DoD and Service Acquisition Executives (SAEs)

Single Face to the Acquisition Community

DoD and the Services must develop an integrated approach to the digital environment and support it throughout the acquisition community. While current efforts led by the logistics, purchasing, and information technology communities are significant, there is a clear need to integrate these efforts in support of a common vision that is well understood throughout the acquisition community and industry. Responsibilities of the single voice or organization effort includes: (a) coordinating the different initiatives, in support of a common, well articulated vision; (b) having the direct or indirect authority to propagate the vision and ensure adherence; and (c) disseminating the word to PMOs in the field.

Guidance

The PMOs need clear and definitive guidance with respect to developing an integrated digital environment. To achieve substantive increases in efficiency and productivity, requirements to simply access and receive digital data are insufficient. Objectives and approaches should be defined at the DoD-level and widely disseminated throughout the acquisition community; PMs must be aware of what is expected of them, what is possible, and what is available today. Currently this is not the case, and the result is a collection of disparate approaches between the Services and PMOs that may or may not support the goals of the acquisition community into the next century.

Accountability and Incentives

A PM should be held accountable for the total life cycle of the acquisition program, including long-term information requirements and the development of a digital environment to meet them. Milestone and review board decisions should require and assess the integrated digital information environment (i.e., APDE) developed to enhance the acquisition program and mitigate long-term costs. Incentives to reward near term innovation and improvements, particularly those that result in long-term benefits that are realized after the PM departs the PMO, are necessary. Funding to support digital initiatives is essential; efforts to affect long-term cost savings through the development of an APDE should not cause short-term budgetary hardships. Likewise, disincentives should be diminished. Reducing long-term costs should not result in a commensurate reduction in a PMO budget.

Metrics

Lessons learned and metrics that depict genuine benefits in cost, cycle time, efficiency, management, productivity, and life cycle support need developing and wide dissemination. These metrics underscore what is achievable within DoD acquisition programs: PMs require such metrics in order to validate the utility of an APDE and conduct realistic cost-benefit

analyses. Industry examples, while useful and more available, are of lesser value because of operating environments, options, and restrictions that differ between the commercial and Defense acquisition communities.

Interoperability and Standards

Continuing to identify national, international, and industry standards which can be applied to the acquisition process makes sense for DoD. The Services and DoD implementations should clarify requirements, capabilities and restrictions; enable widespread use within DoD; and facilitate interoperability between functional areas and across process boundaries. Further, the Services and DoD actions should not limit the flexibility of the PM, but must support interoperability between the PMO and the information requirements of the larger Service and/or DoD digital infrastructures.

CITIS as a Single Process Initiative

The Defense "single process initiative" is being implemented to reduce the number of government-imposed processes on existing contracts. The DoD needs to consider a similar initiative addressing contractor integrated technical information service (CITIS). The DoD can examine Defense contractors providing multiple CITIS environments to government programs, requiring common CITIS implementations per site or per contractor. There appears to be considerable opportunities for increased program efficiency and bilateral cost avoidance that works to the benefit of both the Government and industry. Requirements generation and CITIS acceptance will improve as CITIS implementations become more standard and capabilities become more widely understood.

Defense Acquisition University (DAU)/Defense Systems Management College (DSMC)

Learn From Industry

Industry has identified and demonstrated significant benefits and cost savings achievable by exploiting information through integrated digital environments (i.e., APDE). The acquisition workforce should be cognizant of these benefits and understand how they can be applied to Defense acquisition programs. Examining the lessons learned from industry, understanding how they are applicable to the Defense acquisition process, and ensuring this knowledge is captured in the education of the acquisition workforce falls upon the shoulders of DAU/DSMC. All PMs and staffs need to understand the potential of a digital environment and have an appreciation of how to exploit such potential within their respective organization.

Center for Excellence

With responsibility for DoD acquisition education and training, DAU needs to become proactive in compiling, reconciling, applying, and disseminating information pertaining to the acquisition process. Development and exploitation of cross functional integrated digital environments can potentially yield significant benefits and help to achieve the objectives of the acquisition reform initiative. DAU, particularly DSMC, needs to become a center for excellence in this area, leading the acquisition workforce into the information age and providing a comprehensive repository of information on requirements, standards, applications, lessons learned, metrics, initiatives, pilot programs, funding, etc.

Tools: Technology and implementations supporting an APDE are evolving at a rapid pace,

making it extremely difficult for PMOs to perform qualitative and quantitative evaluations. Information is needed on products and technology innovations, along with methods in which to conduct evaluations when faced with competing alternatives.

Training the acquisition workforce: The requirements and benefits of APDEs need inclusion in education and training processes. This will both improve understanding and stimulate commitment throughout the acquisition workforce. Training should NOT be confined to functional areas or conducted as a separate process. Rather, incorporate it throughout the programs—stressing the cross functional and integrated nature of a digital environment and how the exploitation of information supports massive process improvements and reengineering.

Simulations and hands-on: DSMC should consider developing a simulated APDE which utilizes many of the tools (i.e., CITIS, workflow manager, integrated databases, cross functional decision making) and clearly demonstrates the potential of such an environment. Reading the books and hearing the words is insufficient. The acquisition workforce needs to see, feel, and fully appreciate how a digital environment can be used to truly realize significant benefits. Team exercises that go through processes involving geographically and functionally separate groups are options. As one group employs an APDE, enabling parallel processing and integrated product team (IPT)-like decision making, the other group steps through using current acquisition methods. As team members identify and examine the differences in process time, paper generation, coordination, efficiency, and cost, the possibilities of an APDE become evident.

Symposiums: The dynamic character of this environment dictates working to remain current and constantly looking forward. DAU should consider sponsoring symposiums and expositions to keep abreast of this emerging field and support the exchange of ideas. DAU sponsorship could ensure that the focus is on the acquisition process as a whole, is relevant to PMs, and includes various DoD and Service initiatives which cross functional and program boundaries. By working with the SAEs, DAU can also ensure that appropriate cross section of the acquisition community is targeted, invited, and in attendance.

Industry

Recognize Goals of Acquisition Reform

Many in commercial industry have created integrated digital environments and become significantly more efficient, more competitive, less bureaucratic, and more profitable. Learning from these examples and trying to realize many of the same benefits is at the heart of the current Defense Acquisition Reform movement. Acquisition managers have greater flexibility and the focus is on faster, better, smarter, and cheaper. The Defense industry is in a excellent position to recognize those DoD requirements which no longer make sense, add bureaucratic burden, reduce efficiency, and jeopardize performance outcomes. To better serve the Defense acquisition community, industry must re-examine historical ways of working with DoD and identify opportunities that may be available to improve the way in which we all do business.

Win-Win Opportunities

Many ideas, particularly with respect to APDEs, offer substantive win-win possibilities. Proactive industry identification of these

opportunities brings them into the acquisition process. Industry needs to share the possibilities of an APDE, demonstrate capabilities to PMOs, and be an active player in the development process. While Government cost reduction is an objective of the PM, new regulations and reform initiatives promote contractor incentives and benefit sharing.

CITIS

CITIS provides a mechanism for information creation, management, access, and use. It is potentially an excellent tool for the PMO, and a source of competitive advantage and revenue for the contractor. Every effort should be made to assist PMOs in recognizing the benefits and potential of a CITIS, but PMO-unique CITIS implementations should be resisted. Multiple CITIS implementations at a contractor facility, or even within an organization, results in duplication of effort, increased cost, and lower overall quality service. Dividing CITIS personnel and technology resources within an organization does not benefit the organization or its Government customer. Perhaps, industry should explore common CITIS environments wherever possible, using a "single process initiative" approach. A recommendation is to start at the facility level and potentially migrate to the corporate level. As CITIS requirements and environments mature, standardization across corporate boundaries may also be feasible.

Standards

As the acquisition community pushes toward a DoD-wide integrated data environment (IDE) vision, the need for standardization and data interoperability becomes imperative. Information and digital data must be able to cross functional, organizational, and corporate boundaries seamlessly. The days of proprietary hardware and software restrictions, data formats, and communication protocols are numbered. Industry, for the most part, has recognized the inherent benefits of standardization, and can further facilitate this process. They should actively pursue the development and use of international, national, and industry standards that facilitate data sharing, exchange, and reuse. Not only will this support Defense acquisition goals, but also organizations at the forefront of this effort will be more attractive and competitive in Defense contract selections and in the global international marketplace.

APPENDIX A

ACRONYMS AND TERMS

APPENDIX A
ACRONYMS AND TERMS

This appendix contains a list of the acronyms and terms used throughout MIL Handbook 59B and this Research Fellows report. The information contained herein is intended for guidance only.

AMC	U.S. Army Materiel Command
ANSI	American National Standards Institute
APDE	Acquisition Program's Digital Environment
APMC	Advanced Program Management Course
ARPA	Advanced Research Projects Agency
ASC	Accredited Standards Committee
ASCII	American Standard Code for Information Interchange
CAC	Contractor's Approach to CALS
CAD	Computer-Aided Design
CAD2	Computer-Aided Design, Second Acquisition
CAE	Computer-Aided Engineering
CALS	Continuous Acquisition and Life-Cycle Support
CALSIP	CALS Implementation Plan
CAM	Computer-Aided Manufacturing
CATIA	Computer Aided Three Dimensional Interactive Applications
CCB	Configuration Control Board
CCITT	Consultative Committee on International Telegraph and Telephone
CDI	Compact Disk Interactive
CDRL	Contract Data Requirements List
CD-ROM	Compact Disk - Read Only Memory
CE	Concurrent Engineering
CGM	Computer Graphics Metafile
CIM	Corporate Information Management/Computer Integrated Manufacturing
CITIS	Contractor Integrated Technical Information Service
CLIN	Contract Line Item Number
CM	Configuration Management
CMIS	Configuration Management Information System
CMP	Configuration Management Plan
CMS	Combat Mobility System

CONOPS	Concept of Operations
COTS	Commercial-Off-The-Shelf
CRADA	Cooperative Research and Development Agreements
DAB	Defense Acquisition Board
DAP	Document Application Profile
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DFARS	Defense Federal Acquisition Regulation Supplement
DID	Data Item Description
DII	Defense Information Infrastructure
DISA	Defense Information System Agency
DISN	Defense Information Systems Network
DLA	Defense Logistics Agency
DLSC	Defense Logistics Services Center
DMRD	Defense Management Review Decision
DoC	Department of Commerce
DoD	Department of Defense
DoDD	Department of Defense Directive
DSMC	Defense Systems Management College
DTD	Document Type Definition
DTIC	Defense Technical Information Center
DUSD(AR)	Deputy Under Secretary of Defense (Acquisition Reform)
DUSD(L)	Deputy Under Secretary of Defense (Logistics)
DVI	Digital Video Interactive
E-mail	Electronic mail
EC	Electronic Commerce
ECP	Engineering Change Proposal
ECRC	Electronic Commerce Resource Center
EDI	Electronic Data Interchange
EDIF	Electronic Design Interchange Format
EDIFACT	Electronic Data Interchange For Administration, Commerce, and Transportation
EFOGM	Enhanced Fiber Optic Guide Missile
EFT	Electronic Funds Transfer
EIA	Electronic Industries Association

FACA	Federal Advisory Committee Act
FACNET	Federal Acquisition Computer Network
FAR	Federal Acquisition Regulation
FASA	Federal Acquisition Streamlining Act
FCIM	Flexible Computer Integrated Manufacturing
FDDI	Fiber-Optic Distributed Data Interface
FEA	Functional Economic Analysis
FIPS	Federal Information Processing Standard
FOSI	Formatting Output Specification Instance
FTAM	File Transfer, Access, and Management
GCO	Government Concept of Operations
GDD/D	Global Data Dictionary and Directory
GDMS	Global Data Management System
GE	General Electric
GFI	Government Furnished Information
GOSIP	Government Open System Interconnect Profile
GOTS	Government-Off-The-Shelf
GUI	Graphic User Interface
HPCC	High Performance Computing and Communications
HTML	HyperText Mark-up Language
IAW	In Accordance With
IC	Integrated Circuit
ICP	Institute for Interconnecting and Packaging Electronic Circuits
IDA	Institute for Defense Analysis
IDE	Integrated Data Environment
IEEE	Institute of Electrical and Electronics Engineers
IETM	Interactive Electronic Technical Manual
IGES	Initial Graphics Exchange Specification
IMIP	Industrial Modernization Incentive Program
IMP	Infrastructure Modernization Programs
IMS	Information Management System
IP	Internet Protocol
IPD	Integrated Product Development
IPPD	Integrated Product and Process Development
IPT	Integrated Product Team

IRAD	Independent Research and Development
IRMC	Information Resources Management College
ISDN	Integrated Services Digital Network
ISG	Industry Steering Group
ISO	International Standards Organization
IWSDB	Integrated Weapon Systems Database
JAST	Joint Advanced Strike Technology
JCALS	Joint Computer-aided Acquisition and Logistics Support
JEDMICS	Joint Engineering Data Management and Information Control System
JLSC	Joint Logistics Service Center
JSF	Joint Strike Fighter
LAISO	Lead AMC Integration Support Office
LAN	Local Area Network
LCCE	Life Cycle Cost Estimate
LCD	Least Common Denominator
LORA	Level Of Repair Analysis
LSAP	Logistics Support Analysis Plan
MACS	Mutually Agreeable Commercial Software
MAISRC	Major Automated Information System Review Council
MANTECH	Manufacturing Technology
MIS	Management Information System
MLS	Multi-Level Secure
MTC	Manufacturing Technology Centers
NASA	National Aeronautics and Space Administration
NDI	Non-Developmental Item
NII	National Information Infrastructure
NISA	National Security Industrial Association
NIST	National Institute for Standards and Technology
NLOS	Non-Line of Sight
NTIS	National Technical Information Service
OEM	Original Equipment Manufacturer
OSD	Office of the Secretary of Defense
OSI	Open Systems Interconnection
OUSD (A&T)	Office of Under Secretary of Defense (Acquisition and Technology)
PDES/STEP	Product Data Exchange Using STEP/Standard for the Exchange of Product Model Data

PDL	Page Description Language
PEO	Program Executive Office
PM	Program Manager
PMO	Program Management Office
POSIX	Portable Operating System Interface
PSA	Principal Staff Assistants
QA	Quality Assurance
QE	Quality Engineering
RAMP	Rapid Acquisition of Manufactured Parts
R&M	Reliability and Maintainability
RFD	Request for Deviation
RFP	Request For Proposal
RFQ	Request For Quotes
RFW	Request for Waiver
ROI	Return on Investment
SAE	Service Acquisition Executive
SECDEF	Secretary of Defense
SEMP	System Engineering Management Plan
SGML	Standard Generalized Markup Language
SOW	Statement Of Work
SPA	Solicitation Package Automation
SQL	Structured Query Language
SRL	SGML Reuse Library
STEP	Standard for the Exchange of Product Model Data
TCP	Transmission Control Protocol
TDP	Technical Data Package
TEMP	Test and Evaluation Master Plan
TM	Technical Manuals
TRM	Technical Reference Model
TRP	Technology Reinvestment Project
TSS	Telecommunications Standards Sector
UN/EDIFACT	United Nations/Electronic Data Interchange for Administration, Commerce, and Transport
USD(A&T)	Under Secretary of Defense (Acquisition and Technology)
VAN	Value-Added Network

VE	Value Engineering
VECP	Value Engineering Change Proposal
VHDL	Hardware Description Language
VHSIC	Very High Speed Integrated Circuit
WAN	Wide Area Network
WBS	Work Breakdown Structure
WMRM	Write Many Read Mostly
WORM	Write Once Read Many
WWW	World Wide Web

APPENDIX B

STANDARDS

APPENDIX B
STANDARDS

The Department of Defense (DoD) is actively working to reduce the number of unique standards and practices it requires. To achieve this goal, DoD is presenting its requirements to national and international standards organizations such as the American National Standards Institute (ANSI), the International Standards Organization (ISO), and the United Nations/ Electronic Data Interchange for Administration, Commerce, and Transport (UN/ EDIFACT) to influence standards development and modification. Within the digital environment, there are many standards that have much potential within acquisition programs. Perhaps the most important are those that are specifically designed to support the areas of Electronic Data Interchange (EDI) and Continuous Acquisition and Life-Cycle Support (CALS).

CALS and EDI standards can be used together to improve digital data interchange within all of DoD's key business areas. Functional users within DoD's systems acquisition, contracting, procurement, and logistics business areas are analyzing, testing, and preparing to take advantage of the benefits derived from the synergy between CALS and EDI regarding technical data exchange. In addition to the traditional purchasing transaction function of EDI, the ANSI X12 standard is being developed for and used within DoD's engineering, acquisition management, manufacturing, quality, transportation, and finance functions to transmit digital technical data as well. Functional DoD system users see the synergy between CALS and EDI as greatly improving their data intensive processes. The DoD and industry continue to identify business process improvements and cost savings by using CALS standards for data and transmitting it via EDI transaction sets.[1]

EDI Development and Standards

ANSI

This Institute is the coordinator and clearinghouse for national standards in the United States. The ANSI does not develop national standards; it charters organizations called Accredited Standards Committees (ASCs) composed of voluntary representatives from industry, labor, consumer, and government to prepare consensus standards. Upon public comment and approval, ANSI ASCs publish national standards.[2]

EDI Transaction Sets

For the acquisition program manager (PM) a key set of standards are ANSI X12, which describe standards for EDI. An EDI transaction involves the transmission of a business document in the form of a transaction set that is prepared in accordance with an ANSI X12 standard for that document. In other words, a transaction set is the electronic equivalent of a document, such as a Purchase Order or Request for Quotation, enclosed in an "electronic envelope." There are currently almost 200 transaction sets supporting a variety of business areas (see Appendix C) that are already in use by private industry today.[3] EDI represents an investment in a mature and tested methodology and technology with potentially immediate savings in information processing and maintenance costs for both the Federal Government and industry. It will also allow all stakeholders to take advantage of commercial-off-the-shelf (COTS) ANSI X12 compliant translation software and services.[4]

EDIFACT

In addition to ANSI X12 standards, there is another UN sponsored set of EDI standards called EDIFACT. The EDIFACT standards are primarily used in Europe and Asia. However, in order for everyone to benefit from a single global EDI standard, ANSI X12 has agreed to begin a gradual alignment with EDIFACT in 1997. All PMs should be cognizant of the transition when implementing EDI capabilities.[5]

CALS Standards

The DoD is applying established national and international standards to support the development of a truly integrated data environment (IDE). A key area is those standards that apply to the format and structure of digitized data. The standards described below, with MIL-STD designation, are indicative of these efforts. In many cases, DoD has approved the inclusion of these standards, without waiver for use, within acquisition contracts.[6]

SGML (Standard Generalized Markup Language) (ISO 8879)

Defined in MIL-STD-1840 as: "A standard that defines a language for document representation which formalizes markup and frees it of system and processing dependencies. It provides a coherent and unambiguous syntax for describing whatever a user chooses to identify with the document." HyperText Markup Language (HTML), the markup language used to portray and link documents/data on the world-wide web (WWW), is a modified subset of SGML. The SGML provides mechanisms for tagging, identifying, and accessing elements within a file such that they can later be extracted and used in a variety of ways for different uses. One valuable use for SGML is supporting the generation of Technical Manuals (TM) and Interactive Electronic Technical Manuals (IETM) by extracting data from different source files. When considering SGML as a deliverable format, the technical data manager must determine whether the applicable Document Type Definition (DTD) and Formatting Output Specification Instances (FOSI) exist and whether the necessary computer environment is available and in place to accept the SGML documentation. SGML requirements are described in Mil-M-28001.[7]

Graphics Formats

There are three principle graphics formats that are used to depict physical information Computer Graphics Metafile (CGM), Initial Graphics Exchange Specification (IGES), and raster.[8]

CGM (ISO 8632): A two-dimensional vector presentation used primarily for charts, figures, and simple drawings. CGM is the preferred format for incorporating graphical digital data into TM. Graphical enhancement has been added to the format, including complete integration of tiled compressed raster. Application structuring is currently in the process of being added to the CGM format. Extensions will allow CGM generators to tag "objects" for application significance. It will therefore serve to meet the needs of leading edge and future applications of hyperText and hypermedia documents, multimedia documents, IETMs, network-distributed graphical applications, and graphic object databases. CGM is further described in Mil-D-28003.[9]

IGES (ANSI Y14.26M): A three-dimensional vector presentation used primarily for engineering drawings. IGES may be the preferred choice for graphical data if a Computer-Aided Design (CAD) database were used as

the source. IGES is an ANSI standard which provides a neutral data format for exchanging mechanical product data. IGES was not originally intended to capture extensive product information for the entire product life cycle. Strategies for migrating IGES to Product Data Exchange using STEP (Standard for the Exchange of Product model data) (PDES) are being proposed by and discussed within the U.S. standards development bodies. IGES is further described in Mil-D-28000.

CCITT Raster Group 4 (CCITT T.6): A binary representation of an image. There are two types of raster data, tiled and untiled. Untiled raster data have no document architecture and are represented by a single compressed data entity. Tiled raster data resemble a two-dimensional grid with each tile or set of pixels representing a portion of an image. Previously CCITT stood for Consultive Committee on Telegraph and Telephone, but the organization has changed its name to Telecommunications Standards Sector (TSS). Raster is further described in Mil-D-28002.

STEP (ISO 10303)

An international standard which is being developed to give a complete computer-interpretable representation of product data in a neutral format throughout the complete product life cycle (design, engineering analysis, manufacture, support and maintenance, and disposal. This representation makes it suitable not only for file exchange but also as a basis for implementation, sharing, and archiving product databases.[10] With the proliferation of Computer-Aided Design, Computer-Aided Manufacturing, and Computer-Aided Engineering systems (CAD/CAM/CAE), all product data can be captured in digital form. The ability to transfer such product data in computer-readable format from one system to another is essential. STEP, while in use today, is a developing standard. However, once defined and implemented, it should enable such systems to accept, use, and exchange product data so that developers, suppliers, vendors, manufacturers, maintainers,

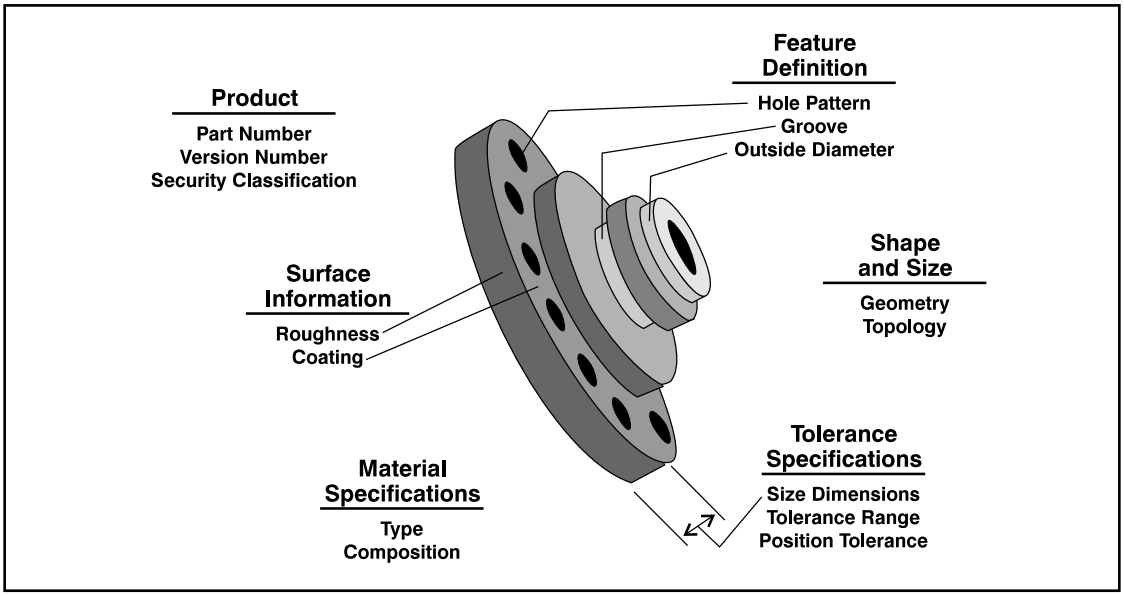

Figure B-1. Example of a STEP Data File

and users will be able to receive and supply information about product parts and materials digitally. An example of a STEP data file is depicted in Figure B-1 (Figure 11-2 from CALS Desktop Guide, pp. 11-54). Also refer to PDES below.

PDES

The PDES is being developed as a national standard, while being the U.S. counterpart to the STEP international standard.[11]

1. Tritle, G. (June 1996). CALS and EDI merging into the business lane of DoD and industry. (Unpublished paper by EDI Manager, Air Force PDSM Program Office). [On-line]. Available Internet: http://wpaftb1.wpafb.af.mil/ec_edi.html#edi2

2. DoD Electronic Commerce. (June 1996). Introduction to Department of Defense electronic commerce: A handbook for business, version 2. p. 25. Department of Defense, Deputy Under Secretary of Defense (Acquisition Reform). Washington, DC: Author.

3. Ibid.

4. Ibid., p. 27.

5. Ibid.

6. Defense Information Systems Agency. (May 1996). Memo from DISA allowing CALS standards and specifications to be used without waiver. [On-line]. Available Internet: http://www.iso/redstone.army.mil/laiso/waiver.html

7. DoD CALS Office. (September 29, 1995). Program manager's desktop guide for continuous acquisition and life-cycle support (CALS) implementation. p 6-16. Washington, DC: Author.

8. DoD CALS master plan, annex 2, vol. 1. (December 1995). [On-line]. Available Internet: http://www.acq.osd.mil/cals/annex_2.html

9. Ibid.

10. DoD CALS Office. (September 29, 1995). Program manager's desktop guide for continuous acquisition and life-cycle support (CALS) implementation. p. 10-53. Washington, DC: Author.

11. Ibid., p. G-13.

APPENDIX C

LIST OF ANSI X12 STANDARDS

APPENDIX C
LIST OF ANSI X12 STANDARDS

The following is a list of ANSI X12 Version 3050 transaction sets (standards available for business documents). Some Government activities are using 2003, 3010, and 3040. Refer to Chapter 8, *Introduction to DoD Electronic Commerce; A Handbook for Business*, dated June 1996, for a discussion of Implementation Conventions. It is included here to illustrate the wide business applicability of Electronic Data Interchange (EDI), and the potential for EDI to be used in standard Government acquisition related business transactions.

ANSI ASC X12 RELEASE 003050 TRANSACTION SETS ARRANGED FUNCTIONALLY

NOTE:

Items in **bold** are standards added in Version 003060
b = In ballot
d = In development
e = DoD EC Program Office execution
* = Has Government Implementation Convention. Government Implementation Conventions are available for Versions 003050 or earlier. Please coordinate your use of a specific convention with your Government Trading Partner.

COMMUNICATIONS AND CONTROLS

242	**Data Status Tracking**
259 d	Error Reporting Immediate Response
815	Cryptographic Service Message
868	Electronic Form Structure
997 e,*	Functional Acknowledgment

PRODUCT DATA

140 *	Product Registration
141	Product Service Claim Response
142	Product Service Claim
143	Product Service Notification
241 d	Binary Data File Transfer
243 d	Request for Product Source Information
244 d	Product Source Information
841 e,*	Specifications/Technical Information
842 e,*	Nonconformance Report
848 *	Material Safety Data Sheet
863 *	Report of Test Results
864 e,*	Text Message

135	Student Loan Application
139	Student Loan Guarantee Result
144	Student Loan Transfer and Status Verification
155 d	Credit Report
156 d	Entitlement Payment Recipient Account Inquiry/Response
190	Student Enrollment Verification
191	Student Loan Pre-Claims and Claims
197 d	Real Estate Title Evidence
198 d	Loan Verification Information
199 d	Mortgage Settlement Information
200	Mortgage Credit Report
201	**Residential Loan Application**
203	**Secondary Mortgage Market Investor Report**
205 d	Mortgage Note
206 d	Real Estate Mortgage Inspection Request
207 d	Real Estate Mortgage Inspection Result
208 d	Income Property Appraisal Report
209 d	Condominium Appraisal Report
260	Application for Mortgage Insurance Benefits
261 b	Residential Appraisal Request
262	**Residential Appraisal Report**
263	Residential Mortgage Insurance Application Response
264	Mortgage Loan Default Status
265	Real Estate Title Insurance Services Order
266	Mortgage Record Change
810 e,*	Invoice
811 *	Consolidated Service Invoice/Statement
812 *	Credit/Debit Adjustment
819	Operating Expense Statement
820 *	Payment Order/Remittance Advice
821	Financial Information Reporting
822	Customer Account Analysis
823	Lockbox
824 e,*	Application Advice
827	Financial Payment Return Order/Return Notice
828	Debit Authorization
829	Payment Cancellation Request
831	Application Control Totals
833	Mortgage Credit Report Order
844	Product Transfer Account Adjustment
849	Response to Product Transfer Account Adjustment
872	Residential Mortgage Insurance Application
880	Grocery Products Invoice

149 d	Notice of Tax Adjustment or Assessment
150	Tax Rate Notification
151	Electronic Filing of Tax Return Data Acknowledgment
152	Statistical Government Information
154	Uniform Commercial Code Filing
156 d	Entitlement Payment Recipient Account Inquiry/Response
175	Court Notice
176 *	Court Submission
185	Royalty Regulatory Report
194 d	Grant or Assistance Application
195	Federal Communications Commission (FCC) License Application
196 *	Contractor Cost Data Reporting
251 *	Pricing Support
280 d	Voter Registration Information
281 d	Elections Results Reporting
501	**Vendor Performance Review**
502 d	Solicitation Mailing List
505 d	Procurement Support
506 d	Procurement Notice
511 *	Requisition
517 *	Material Obligation Validation
525 d	Asset Disposition
527 *	Material Due-In and Receipt
536 *	Logistics Reassignment
561 *	Contract Abstract
567 *	Contract Completion Status
568 *	Contract Payment Management Report
805 *	Contract Pricing Proposal
806	Project Schedule Reporting
813	Electronic Filing of Tax Return Data
826	Tax Information Reporting
836 e,*	Procurement Notices
838 e,*	Trading Partner Profile
839	Project Cost Reporting
996	File Transfer

MATERIALS MANAGEMENT

830 *	Planning Schedule With Release Capability
846 *	Inventory Inquiry/Advice
847	Material Claim
853	Routing and Carrier Instruction
856 e,*	Ship Notice/Manifest
857	Shipment and Billing Notice
861 *	Receiving Advice/Acceptance Certificate
862	Shipping Schedule
866	Production Sequence
867	Product Transfer and Resale Report
869 e,*	Order Status Inquiry
870 e,*	Order Status Report
871 b	Component Parts Content

TRANSPORTATION

104	**Air Shipment Information**
110	**Air Freight Details and Invoice**
120	Vehicle Shipping Order
121	Vehicle Service
125	Multilevel Railcar Load Details
126	Vehicle Application Advice
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218	Motor Carrier Tariff Information
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353 U.S. Customs Events Advisory Details
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357 U.S. Customs In-Bond Information
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924	Loss or Damage Claim – Motor Vehicle
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879	Price Change
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889	Promotion Announcement
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893	Item Information Request
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895	Delivery/Return Acknowledgment or Adjustment
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947	Warehouse Inventory Adjustment Advice

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APPENDIX D

CONTACTS

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CONTACTS

In conducting this research, information was gathered from a wide variety of sources. In addition to written literature and studies, over 100 interviews were conducted with key persons and offices representing a broad spectrum within Government, industry, and academia. The following lists some of the many organizations that played a major role in our research and findings. In most cases, the formal interviews listed below were recorded and transcribed.

GOVERNMENT

Air Force CALS Program Office (AFCPO)
PMO staff, Wright Patterson Air Force Base, OH, January 96

Air Force PDSM Program Office
Electronic interviews with EDI Manager, Wright Patterson Air Force Base, OH, January-May 96

Army Combat Mobility Systems (CMS) Program Office
PMO staff, Warren, MI,(March 96
Program Manager (COL Paul), Warren, MI, March 96
Program Manager (COL Paul), Fort Belvoir, VA, March 96
Assistant Program Manager (Logistics) (Ms. Moulton), Fort Belvoir, VA, April 96

Army Lead AMC Integration Support Office (LAISO)
Telephonic and electronic interviews, March-April 96

Army Logistics Integration Agency
CALS office, Alexandria, VA, March 96

Army Materiel Command (AMC)
CALS Requirements Integration Office, Alexandria, VA, April 96
EC/EDI Project Office, Alexandria, VA, April 96

B-2 Program Management Office
Electronic and telephonic interviews, May 96

C-17 Program Management Office (PMO)
PMO staff, Wright Patterson Air Force Base, OH, April 96

Configuration Management and Information Systems (CMIS) Project Office
Project manager and staff, Wright Patterson Air Force Base, OH, April 96

Defense Construction Supply Center
Commanding Officer (RADM Elliot), Fort Belvoir, VA, February 96

Defense Systems Management College (DSMC)
Faculty interviews, Fort Belvoir, VA, December-June 96

Department of the Treasury
Office of Telecommunications Management, Arlington, VA, February 96

Deputy Under Secretary of Defense for Acquisition Reform
Director of Programs Acquisition Strategies Improvement (Mr. Sylvester), Pentagon, VA, February 96

Deputy Under Secretary of Defense for Logistics
DUSD(L) (Mr. Phillips), Pentagon, VA, May 96

DoD CALS Office
Deputy Director (Mr. Adams), Crystal City, VA, January 96
Functional area managers, Crystal City, VA, February 96
Director (Ms. Litman), Crystal City, VA, May 96
Incoming Director (Mr. Adams), Crystal City, VA, June 96

DoD Electronic Commerce (EC) Office
Director (Ms. Smith), Pentagon, VA, April 96

DoD, Office of the Inspector General
Contract Management Directorate, Crystal City, VA, March 96

F-22 Program Management Office
PMO staff, Wright Patterson Air Force Base, OH, April 96

F/A-18 PMA
PMA staff, Crystal City, VA, April 96

JCALS Program Office
Electronic Interviews and discussions, Fort Monmouth, NJ, February-April 96

JEDMICS Pilot Site
Program staff, Warner Robbins AFB, GA, April 96

Joint Strike Fighter (JSF) Program Office
PMO staff, Crystal City, VA, March 96

Joint Surveillance Targeting and Attack Radar System (JSTARS) Program Office
PMO staff, Hanscom AFB, MA, April 96

Naval Air Systems Command (NAVAIR)
NAVAIR Digital Program Office, Crystal City, VA, April 96

Navy CALS Office
Program staff, Crystal City, VA, April 96

NAVAIR Multi-Mission Helicopter Program Office (PMA-299)
Program staff, Crystal City, VA, April 96

Secretary of the Army for Research, Development and Acquisition (SARDA)
CALS/EC/EDI personnel, Pentagon, VA, March 96

Theater High Altitude Air Defense (THAAD) Program Office
Electronic and telephonic interviews, Huntsville, AL, February-May 96

V-22 Program Office
PMO staff, Crystal City, VA, April 96

INDUSTRY

Ball Aerospace
Government Division, Boulder, CO, February 96

Boeing Aircraft Division
Defense and Space Group, Seattle, WA, March 96

CALS Industry Steering Group (ISG)
Multiple interviews and discussions, February-July 96

Coopers and Lybrand Consulting
IDEBAT development team, Arlington, VA, May 96

Draper Laboratories
Electronic Media office, Boston, MA, April 96

Electronic Commerce Resource Center (ECRC)
Director and staff, Fairfax, VA, January-March 96

General Electric
Evandale, OH, February 96

George Mason University
Fairfax Information Technology Center, Fairfax, VA, February 96

Hughes Aircraft Corporation
El Segundo, CA, April 96

KPMG Peat Marwick
Data Acquisition Study team, Dayton, OH, April 96

LLD, Incorporated
CALS support office, January 96

Lockheed Martin
Electronic Commerce office, Denver, CO, March 96
Agile Infrastructure for Management Systems (AIMS) pilot program, Sunnyvale, CA, March 96
Missiles and Space Division, Sunnyvale, CA, March 96
IETM development team, Fort Worth, TX, April 96
Tactical Aircraft Systems, Fort Worth, TX, April 96

McDonnell Douglas Corporation
CALS program development office, Long Beach, CA, March 96
F/A-18 digital initiatives team, Crystal City, VA, April 96

Northrop Grumman
Electronic Sensors and Systems Division, Hawthorne, CA, March 96
Military Aircraft Division, Hawthorne, CA, March 96

PRC Incorporated
JEDMICS consultant team, McLean, VA, April 96

TASC
IDEBAT consultant team, Arlington, VA, May 96
Director, Special Projects, Arlington, VA, June 96

Westinghouse
Government Division, Baltimore, MD, March 96

APPENDIX E

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